APPENDIX A

Lefthand Watershed
Collaborative Sampling Documents

APPENDIX A-1
Sampling and Analysis Plan

LEFTHAND WATERSHED

Sampling and Analysis Plan

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CONTENT

TABLES

1.0 INTRODUCTION

This Sampling and Analysis Plan SAP describes the sampling, analysis and assessment methods that will be used for the following listed segments:

- Little James Creek
- James Creek and tributaries
- Lefthand Creek and tributaries

The Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE) will coordinate environmental and water quality assessments and funding efforts within the Lefthand Watershed. This effort will promote a holistic approach to assure coordination in establishing and achieving environmental cleanup and water quality goals. A key component of this effort will be assuring participation between local, state and federal stakeholders.

There were synoptic surface water quality studies and data collection efforts focused on metals in the Lefthand Watershed by University of Colorado in 2002 and 2003. Under a current 319 EPA grant, a water quality assessment report of the Lefthand Watershed is being written by the Lefthand Watershed Oversight Group (LWOG). The focus will be to summarize the most relevant current and historic water quality work on-going in the Lefthand watershed. Sampling and analysis activities in 2004 will be conducted by the USFS, USGS, CDPHE and EPA with assistance from University of Colorado.

2.0 PROBLEM DEFINITION

2.1 Lefthand Watershed

The Left Hand Creek watershed lies in north central Colorado on the east slope of the Front Range of the Rocky Mountains north west of the city of Boulder. It drains about 85 square miles of an area ranging in elevation from nearly 14,000 feet at the Continental Divide east to about 4800 feet on the Plains where it discharges to St. Vrain Creek in Longmont, Colorado. Left Hand Creek, James Creek and Little James Creek are the only perennial streams in the watershed, however, there are numerous intermittent stream channels. The basin discharges an average of about 28,840 acre feet annually. Left Hand Creek and James and Little James Creeks are part of the Colorado Headwaters Hydrologic Unit Code 10190005. Left Hand Creek and James Creek are located in Boulder County just north of Boulder, Colorado. Little James Creek flows into James Creek, which flows into Left Hand Creek.

Left Hand Creek and Little James Creek are listed on the State of Colorado's 1998 303(d) list as impaired for not supporting the aquatic life use classification. Both waters are listed with a high priority for Total Maximum Daily Load (TMDL) development. The listing specified that the numeric standards for cadmium, iron, manganese, zinc and pH, were not being attained. Additional dissolved metals data have shown that standards for copper and lead are also exceeded. The water quality in Left Hand Creek, James Creek and Little James Creek is affected by discharges from various mines and waste rock and mine tailings in the area. The drainage area encompasses the historical Captain Jack and Golden Age mining districts and receives runoff from a number of rock dumps, mill tailings and abandoned mining sites. These areas were mined for gold, lead, silver, fluorspar (calcium fluoride) and uranium.

Although there are numerous mines throughout the watershed, only one mine is currently on the National Priorities List. This is the Captain Jack Mine and Mill, located in the upper portion Left Hand Creek. A remedial investigation is planned to begin at the Captain Jack Mine in FY 2004. The EPA and CDPHE under CERCLA have investigated two others. They are the Golden Age Mine located in Little James and James Creek, and the Slide Mine/Corning Tunnel, located in the middle portion of Left Hand Creek The site investigation for the Slide Mine/Corning Tunnel was conducted during FY 2003 EPA, State, and local partners are currently developing a strategy to address the Slide Mine/Corning Tunnel site.

The James Creek watershed covers approximately 36 square miles from its source near Ward to its confluence with Left Hand Creek. The Little James Creek watershed area only encompasses about three square miles.

The Jamestown's water supply intake is located in James Creek upstream of the inflow from Little James Creek. The Left Hand Water District serves drinking water to between 11,000 to 16,000 people in rural Boulder and Weld Counties. Left Hand Creek supplies water to Boulder Reservoir via Left Hand Reservoir. Twenty to sixty percent of the water in Boulder Reservoir, a water supply for the City of Boulder, can come from this source. The City of Boulder system supplies drinking water to 105,000 people.

3.0 Project Objectives

The primary goals of this investigation are to:

- Evaluate water quality in the various drainages within the Land Hand Creek Watershed;
- Conduct habitat studies to determine how well the waterbodies are functioning as habitat for fish, and other aquatic organisms;
- Conduct flow measurements to aid in evaluating existing metals loads to the watershed and potential sources of metals loading to the watershed;
- Use the data to assist in making feasibility and remedial cleanup decisions for the watershed in an effort to meet existing water quality standards that adequately protect human health and the environment in the watershed.

4.0 Lefthand Creek

4.1 Summary of Available Data

UOS (URS Operating Services) conducted field work at the Captain Jack Mill (CJM) site on June 25 and 26th, 1997. The CJM site is located about 1.5 miles south of Ward. The investigation involved the collection of 26 samples for laboratory analysis and the collection of non-site specific information. Surface water and sediment samples collected along Left Hand Creek and its tributaries on June 25 and 26, 1997, indicated elevated concentrations of aluminum, calcium, copper, iron, lead, magnesium, manganese and zinc. Furthermore, calculations indicated a sizable amount of metals loading to Left Hand Creek that is attributed to the Big Five Mine adit discharge. Left Hand Creek exhibited evidence of contamination from both the CJM site and the Big Five Mine adit. Evidence of contaminant migration from the CJM site was exhibited by fine grained materials (possibly tailings) present along the stream bank immediately adjacent to the mill site. Additional evidence of contamination took the form of an orange precipitate lining the bottom of portions of Left Hand Creek and the channel of the Big Five Mine adit drainage.

The Hazardous Materials and Waste Management Division (HMWMD) of the Colorado Department of Public Health and Environment (CDPHE), under a cooperative agreement with the U.S. Environmental Protection Agency (EPA), conducted a Combined Assessment if the Slide Mine/Corning Tunnel area in Fall 2002 and Spring 2003. The CA called for the collection of 24 field samples consisting of 4 solid source, 2 aqueous source/adit, 5 surface water. 5 sediment samples and 5 aqueous QA/QC samples. The Slide Mine site covers an area of approximately 12 acres near the town of Rowena. The mine is situated 0.65 miles west of Rowena along Lefthand Creek Road at an elevation of 8,200 feet. The Slide mine is located on the south side of Lefthand Creek on the hillslope overlooking the Left Hand Creek drainage. The mine is situated on the hill terrace approximately 1000 feet above Left Hand Creek. Analysis of surface water samples collected from Left Hand Creek did not indicate a release of contaminants to the stream from the mine adit and during periods when site conditions are steady. However, sediment samples collected from Left Hand Creek downstream of the probable point of entry for site contaminants indicate that pile materials are migrating from the site to the drainage and are present at elevated concentrations in sediments 0.3 miles downstream of the site. CDPHE also performed a high-flow sampling event on April 18, 2003. Field observations made on this sampling date indicated that the site was discharging to Left Hand Creek.

Surface water and sediment data was collected by University of Colorado in 2002 and 2003 and the results indicated exceedances of the State of Colorado acute and chronic criteria for dissolved metals for copper and zinc.

Sediment
The Left Hand Water District experiences ongoing problems with sediment deposition at their intake on Lefthand Creek. This District has spent hundreds of thousands of dollars recently in efforts to mitigate the impact of these sediments. The District spends many man and equipment hours each year removing sediment from their intake structures.

Nutrients
There are potential nutrient loading concerns from the cumulative impact of Individual Sewage Disposal Systems (ISDS). The nutrient of concern for this effort is Total Phosphorus.

4.2 Proposed Monitoring Strategy for the Left Hand Creek

Tracer studies will be conducted by University of Colorado in March 2004 to determine metal loading throughout the basin. A synoptic study will be conducted in May and November, 2004 to characterize nutrient, sediment, metals and flow conditions on James Creek. Biological samples will be collected following protocols recommended by Will Clemens at CSU and described in section 6.0. The following parameters will be collected at various sites:

- *Field Parameters* – Temperature, flow, dissolved oxygen, pH, conductivity
- *Laboratory Parameters* – total phosphorus (TP), total suspended solids (TSS), total and dissolved metals, dissolved organic carbon (DOC), turbidity and hardness
- *Physical Habitat Parameters* – Particle size analysis, Rapid Bioassessment Protocols (Barbour, et al. 1999), pebble counts
- *Biological Parameters* – Macroinvertebrates (species composition and tissue analysis for metals)

5.0 James Creek

5.1 Summary of Available Data

The Golden Age Mining district contributes runoff to James Creek. Jenks Gulch, Castle Gulch, Hill Gulch and other drainages may be contributing additional metals to James Creek. Indications are that metals are not impacting James Creek upstream of Little James Creek. Metals concentrations at these sites were often below detection. An ecological investigation of the water quality of the upper James Creek (Duren, 2001) found that roads and off road vehicle activity may have had a negative affect on the ecosystem health of James Creek.

Data collected by the University of Colorado in July of 2002 indicated exceedances of the acute criteria for zinc in upper James Creek and exceedances of the acute criteria for copper and zinc at the point of confluence with Little James Creek. Data collected by RiverWatch indicate exceedance of acute criteria for copper in Upper James near Chipmunk Gulch and below Overland Mountain.

5.2 Proposed Monitoring Strategy for James Creek

A tracer study will be conducted in March 2004 by the University of Colorado to assess metal loading in the watershed. A synoptic study will be conducted in May and October, 2004 to characterize nutrient, sediment, and flow conditions on James Creek. Biological samples will be collected following Rapid Bioassessment Protocols. The following parameters will be collected at each site:

- *Field Parameters* – Temperature, flow, dissolved oxygen, pH, conductivity

- *Laboratory Parameters* – total phosphorus (TP), total suspended solids (TSS), total and dissolved metals, dissolved organic carbon (DOC), turbidity and hardness
- *Physical Habitat Parameters* – Particle size analysis, Rapid Bioassessment Protocols (Barbour, et al. 1999), pebble counts
- *Biological Parameters* – Macroinvertebrates (species composition and tissue analysis for metals)

5.3 Summary of Available Data for Little James Creek

The Little James Creek/ James Creek watershed drains numerous adits, shafts, and tailings piles within a part of the Jamestown Mining District, including the Burlington, Emmit, and Golden Age Mines. The area was primarily developed for its lead-silver, fluorspar, and uranium deposits. URS Operating Services, Inc. was tasked by the USEPA Region VIII, to conduct an Expanded Site Inspection under the Superfund program at the Golden Age Mine site in Jamestown, Boulder County, Colorado. The second field sampling event was conducted June 1 through 3, 1998. Aqueous samples collected that were collected from Little James Creek show elevated concentrations of the following total and dissolved metals; beryllium, lead, manganese, sodium, thallium, and zinc.

5.4 Proposed Monitoring Strategy for Little James Creek

A tracer study will be conducted in March 2004 by the University of Colorado to assess metal loading in the watershed. A synoptic study will be conducted in May and November, 2004 to characterize nutrient, sediment, and flow conditions on Little James Creek. Biological samples will be collected following RB Protocols. The following parameters will be collected at each site:

- *Field Parameters* – Temperature, flow, dissolved oxygen, pH, conductivity, turbidity
- *Laboratory Parameters* – total phosphorus (TP), total suspended solids (TSS), total and dissolved metals, dissolved organic carbon (DOC), turbidity and hardness
- *Physical Habitat Parameters* – Particle size analysis, Rapid Bioassessment Protocols (Barbour, et al. 1999), pebble counts
- *Biological Parameters* – Macroinvertebrates (species composition and tissue analysis for metals)

6.0 Summary of Monitoring Activities and Sampling Frequencies

6.0 Sampling Procedures

A listing of all of the proposed monitoring sites is presented in Table 6-1. An overall summary of the proposed sampling activities is presented in Table 6-2. The laboratory will provide training to any volunteers that may assist with this sampling project. Field measurements including pH, conductivity, dissolved oxygen, and temperature will be taken at each sampling location listed in Table 1 All meters will be calibrated before use in the field. All field measurements and notations will be recorded in the field notebook.

A team led by Dr. Joe Ryan, Department of Civil, Architectural, and Environmental Engineering, and Alice Wood, a Master's student in the Department of Environmental Studies, will conduct metal loading tracer tests to locate the major sources of metals and acidity in the James Creek watershed. The metal loading tracer tests will be conducted during high- and low-flow stream conditions from April 2003 to August 2004 to investigate the effects of abandoned mines and mill sites on the water quality James Creek Additionally, a mass-balance approach will be used to assess the fate of metals entering the creeks as dissolved and colloidal fractions by measuring the metal content of the stream bed sediments. The results of the metal loading tracer tests will be disseminated to the various stakeholders concerned about water quality in the James Creek watershed to aid in decisions related to abandoned mine and mill site remediation.

Church et al. (1997) and Kimball et al. (2001) demonstrated the utility of tracer injections and synoptic sampling for the determination of metal loadings in stream systems. This study will incorporate tracer tests (the injection of a salt tracer to a stream and subsequent measurement of tracer dilution as it flows downstream), to precisely gauge stream discharge. Synoptic sampling involves collection of stream water samples at regular downstream intervals during the tracer test. Tracer experiment discharge data paired with laboratory analysis (ICP-AES and ICP-MS) of the stream water samples will allow the development of a stream profile of total and dissolved metal loadings.

Personnel from the U.S. EPA Region VIII Office of Technical and Management Services-Laboratory will conduct field measurements, habitat analysis and collect water and macroinvertebrate samples for laboratory analyses of those parameters identified in Tables 6-1 of this sampling plan. All parties involved in this sampling effort will be responsible for the collection and preservation of all samples and their appropriate chain-of-custody requirements. Surface water flow measurements and field parameters will be taken at the same approximate time that water samples are collected following procedures outlined in "Minimum Requirements for Field Sampling Activities" (EPA 1996). The laboratory will provide training to any volunteers that may assist with this sampling project.

Personnel from the CLP laboratory and ESAT team will analyze the sediment, groundwater and surface water samples for metals. The Region 8 EPA lab will analyze select samples for TDS, turbidity, DOC and total phosphorus. Samples will be collected into separate polypropylene containers and chilled for transport to the laboratories. Personnel from the EPA Region 8 lab will supervise the collection, preservation, labeling and shipment, including the appropriate chain-of-custody requirements for all samples they collect for chemical analysis. Sampling station locations for field parameters, habitat analysis, chemical analyses, and macroinvertebrates are presented in Table 6-1. Samples will be collected from the furthest downstream location to the upstream locations in order to minimize cross-contamination.

6.1 Flow Measurements and Field Parameters

Surface water flow measurements and field parameters, including temperature, flow, dissolved oxygen, pH, conductivity will be taken at the same approximate time that water samples are collected following procedures outlined in "Minimum Requirements for Field Sampling Activities" (EPA 1996). Flow measurements will be taken at the same approximate time that the water column and sediment samples are collected. Flow measurements will be made with a Marsh McBirney flow meter and a top-setting wading rod.

6.2 Biological Parameters – Macroinvertebrates (species composition and tissue analysis for metals)

Personnel from the EPA Region VIII lab will collect qualitative and quantitative aquatic macroinvertebrate samples. Replicate benthic macroinvertebrate samples (*n*=3) will be collected using a 0.1-m^2 Surber sampler (500-µm mesh net) from shallow riffle areas (<0.5 m) at selected sites. Substrate will be disturbed to a depth of approximately 10 cm and materials will be sieved using a 500-µm mesh sieve. All organisms retained will be preserved in 70% ethanol in the field. In the laboratory, samples will be sorted and organisms will be identified to the lowest practical taxonomic level (genus or species for most taxa; subfamily for chironomids).

We will measure bioavailability of heavy metals in the field using the filter-feeding caddisfly *Arctopsyche grandis* (Trichoptera: Hydropsychidae). *Arctopsyche* is a relatively large, widely-distributed caddisfly found in many Rocky Mountain streams. Because *Arctopsyche* is highly tolerant of heavy metals, this species can be collected from both reference and metal-contaminated sites. Caddisflies will be collected from field sites, placed in 20 mL acid-rinsed vials and immediately placed on ice. Where possible, replicate samples (n=3) will be collected from field sites. Where available, heptageniid mayflies, a grazer, will also be collected. Metals analysis will be done by the CLP lab using ICP-MS.

Metal bioavailability to aquatic organisms is greatly influenced by levels of dissolved organic carbon (DOC) in water. DOC will be measured at all field sites where macroinvertebrates and periphyton are collected. Water samples will be collected using a 60 mL syringe fitted with a collection tube and glass filter (0.7 mm pore size). Samples will be were preserved with hydrochloric acid (pH = 2.0) and stored at 4^{o}C. DOC will be analyzed at the EPA Region VIII laboratory.

Personnel from the EPA Region 8 Lab will be responsible for picking, sorting and identifying the macroinvetebrate to species level at selected sites. All macroinvertebrates will be identified to the lowest taxonomic level possible. All specimens and debris will be returned to the EPA Region VIII for final disposition. EPA Region VII lab will also be tasked to produce a final report on results from the macroinvertebrate sampling.

6.3 Macroinvertebrate Sorting and Analysis and DOC

In the laboratory, samples will be sorted and organisms will be identified to the lowest practical taxonomic level (genus or species for most taxa; subfamily for chironimids).

Bioavailibility of heavy metals in the field will be measured using the fiter-feeding caddisfly *Arctopsyche Grandis* (Trichoptera: Hydropsychidae). *Arctopsyche* is a relatively large, widely-distributed caddisfly found in many Rocky Mountain streams. Because *Arctopsyche* is highly tolerant of heavy metals, this species can be collected from both reference and metal-contaminated sites. Caddisflies will be collected from field sites, placed in 20 mL acid-rinced vials and immediately placed on ice. Where possible, replicate samples (n=3) will be collected from field sites. Where available, heptageniid mayflies, a grazer, will also be collected. Metal analysis will done using ICP-MS.

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6.4 Pebble Counts

The Zig-Zag Pebble Count Analyzer was developed by Greg Bevenger, Forest Hydrologist, Shoshone National Forest, and Rudy King, Station Statistician, Rocky Mountain Research Station, to help users properly implement the zig-zag pebble count procedure (Bevenger and King, 1995, A pebble count procedure for assessing cumulative watershed effects. Rocky Mountain Forest and Range Experiment Station Research Paper RM-RP-319, 17 pages). The zig-zag method is a pebble count procedure using a zig-zag sampling pattern along a longitudinal stream reach such that a stream is sampled along a continuum instead of an individual site, reach, or cross-section. By doing this, numerous meander bends and all associated habitat features are sampled as an integrated unit rather than as individual cross-sections.

Macro enabled worksheets are provided to help users: (1) estimate sample size, (2) enter field data, (3) produce tables and graphs, (4) perform statistical analysis using contingency tables and the Pearson chi-squared statistic, and (5) make notes. The spreadsheet-workbooks also contain case studies to illustrate typical application of the procedure and provides examples of typical analysis scenarios. The intent is to assist users with the development of study plans and to help them interpret results. The thrust of each analysis is to identify shifts in the fine gravel and smaller portions of the distribution, rather than the median.

6.5 Simple Field Leach Test for Rapid Screening

A field leach test will be used to assess the abandoned mine waste piles. The protocol is based on the paper published by U.S. Geological Survey, 2000 "A Simple Field Leach Test for Rapid Screening and Qualitative Characterization of Mine Waste Dump Material on Abandoned Mine Lands", Hageman, Philip L., Briggs, Paul H.

6.6 Sample Handling and Custody

Bill Schroeder, of the T&MS Laboratory, will be the field sample custodian and will keep records of all samples delivered to the EPA Region VIII laboratory for analyses. Chain of custody procedures will follow those listed in Region VIII's Minimum Requirements for Field Sampling Activities (September 1996).

A chain of custody record will accompany all chemistry samples and will be checked by the appropriate sample custodian. All samples will be tagged with pre-numbered and recorded samples tags.

The tentative types and numbers of analytical samples to be collected (exclusive of QC samples) are listed in Table 6-1).

6.7 Calibration Procedures and Frequency

All meter and laboratory calibration procedures will be conducted according to USEPA requirements and follow the EPA Laboratory's standard operating procedures and the manufacturer's instruction manuals. Electrodes for pH and conductivity determinations will be calibrated with appropriate buffers each day before samples are collected. The dissolved oxygen probe will be calibrated to saturated air prior to use in the field. Thermometer calibration is factory set by the manufacturer and is not required prior to use in the field. In the event that problems are discovered with instruments in the field, maintenance procedures described in the Region VIII Laboratory's SOPs (found on 8-net Intranet) and the manufacturer's instruction manuals will be performed as needed to assure the integrity field measurements.

6.8 Analytical Procedures

All procedures for metals analyses will follow USEPA's "Methods for Chemical Analysis of Water and Waste," 1983. All procedures for macroinvertebrate collection and identification will follow "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers", Second Edition, 1999. Methods for field measurements of pH, conductivity, temperature and dissolved oxygen will follow EPA's "Methods for Chemical Analysis of Water and Wastes," 1983, APHA Standard Methods 16th Edition, the Region VIII SOP for Field Samplers, and the manufacturer's instruction manuals.

Special Instructions:

"Total Recoverable Analyte" means the concentration of analyte determined to be in either a solid sample or an unfiltered aqueous sample following treatment by refluxing with hot dilute mineral acid as defined in Method 200.2 (Methods for the Determination of Metals in Environmental Samples, Supplement 1, EPA/600/R-94/111, May 1994.)

"Dissolved Analyte" means the concentration of analyte in an aqueous sample that will pass through a 0.45-micron membrane filter assembly prior to acidification as defined in Method 200.7 Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma - Atomic Emission Spectrometry, Methods for the Determination of Metals in Environmental Samples, Supplement 1, EPA/600/R-94/111, May 1994.

7.0 QUALITY CONTROL REQUIREMENTS

One quality control sample set for chemical analyses, including a container blank, filter blank and preservative blank, will be collected for every 10 locations sampled in the field. Samplers will also prepare VOC trip blanks in the EPA regional laboratory prior to the initiation of fieldwork. Quality control samples will be used to determine whether or not sampling procedures introduce contaminants in the field. Field duplicates for chemical analyses will also be collected to determine whether or not the data is reproducible.

If QC samples reveal a sampling or analytical problem, field and laboratory personnel will troubleshoot the problem and attempt to identify the source of contamination. Upon working out a plausible solution, personnel will take necessary steps to assure that similar problems will not arise during future sampling events. Data may need to be flagged and qualified depending upon the nature and extent of the contamination.

Quality control checks to be performed by the Region VIII Laboratory, CLP and ESAT are listed in Table 7.0. The precision and accuracy for each chemical parameter will be determined according to the laboratory's SOPs and the EPA methods for Chemical Analysis of Water and Wastes. Laboratory personnel will include a QA/QC report in their final data package to the project manager. Chemical analytical results outside the limits for acceptability prescribed by the T&MS-Laboratory will be reported to William Schroeder and EPA Region 8 RPM Stan Christensen. Corrective action, including instrument recalibration and reanalysis of the sample will be pursued.

7.1 Decontamination Procedures

All sampling equipment will be acid rinsed and rinsed with deionized water between sampling stations. Prior to collecting samples at each new station, the equipment is rinsed three times with native water to further ensure no contaminant carryover. Equipment blanks will also be taken to ensure that the equipment decontamination process is adequate.

7.2 Disposal of Investigation-Derived Wastes

This field effort will involved the collection of minimal Investigation-Derived Wastes (IDW). Equipment rinsate wastes, disposable sampling equipment and personal protective equipment will be collected, contained, or bagged, as appropriate by each field team for proper disposal at the EPA Region VIII Golden, Colorado laboratory.

8.0 Data Quality Objectives Process

The EPA Data Quality Objectives (DQO) Process is a seven step systematic planning approach to develop acceptance or performance criteria for EPA-funded projects. Data quality objectives define the level of scientific rigor required for sample collection, sample analysis and data analysis. The DQOs for the Left Hand Creek Watershed effort are presented in the QAPP, (or see the example Table format I added at the end of this SAP.) The Seven steps of the process are:

1. The Problem Statement
2. Identifying the Decisions
3. Identifying the Decision Inputs
4. Defining the Study Boundaries
5. Developing Decision Rules
6. Defining Tolerable Limits on Decision Errors
7. Optimizing the Sample Design – I don't think all these have been fully addressed in the QAPP yet.

8.1 Criteria for Measurement Data

(See pages 18-21 of the EPA QA/G-5, December 2002.). These measurement performance and acceptance criteria are often expressed in terms of data quality indicators. The seven principle indicators are:

1. Precision - the degree of agreement among repeated measurements of the same characteristic, or parameter, and gives information about the consistency (reproducibility) of the method.
2. Bias – the systematic or persistent distortion of a measurement process that causes errors in one direction.
3. Accuracy - a measure of confidence that describes how close a measurement is to its "true" value.
4. Representativeness -the extent to which measurements actually represent the "true" environmental conditions.
5. Comparability - the degree to which data can be compared directly to similar studies and that one data set can be compared to another and combined for the decision(s) to be made.
6. Completeness - the comparison between the amount of data you planned to collect and analyze versus how much usable data was collected and analyzed. Normally expressed as a percentage.
7. Sensitivity – The capability of a method or instrument to discriminate between measurement responses representing different levels of the variables of interest.

Precision and accuracy for chemical measurements such as pH, temperature, conductivity and dissolved oxygen will be determined according to the EPA Chemical Methods Manual, EPA Region VIII's Standard Operating Procedures (SOP) for Field Samplers, or the manufacturers specifications. Macroinvertebrate data will be analyzed according to the procedures outlined in the EPA RBP Methods Manual. Data acceptability for macroinvertebrate identification may be determined by an outside source such as Colorado State University, or USGS. For this set of samples, precision will be based on one or two stations with a field duplicate for chemical analyses.

8.2 Data Quality Assessment –

Data Quality Assessments (DQA) are prepared to document the overall quality of data collected in terms of the established DQOs. The data assessment parameters calculated from the results of the field measurements and laboratory analyses are reviewed to ensure that all data used in subsequent evaluations are scientifically valid, or known and documented quality, and where appropriate, legally defensible. The goal of the DQA is to present the findings in terms of data usability.

The major components of a DQA are presented below and show the progression of the assessment leading to determination of data usability.

- A QA/QC review of field generated data and observations;
- Individual data validation reports for all sample delivery groups;
- Description of the procedures used to further quality data generated from samples run via dilution, reanalysis, and duplicate analysis;
- Evaluation of QC samples such as, field blanks, trip blanks(N/A), equipment rinsates, field replicates, and laboratory control samples to assess the quality of the field activities and laboratory procedures;
- Assessment of the quality of data measured and generated in terms of accuracy, precision, and completeness throughout the examination of laboratory and field control samples in relation to established objectives and correct application of statistical methods(if applicable); and
- Summary of the usability of the data, any qualifiers and any biases, based on the assessment of data conducted during the previous steps. Sample results for each analytical method will be qualified as acceptable, rejected, or estimated.

9.0 Data Validation and Usability

9.1 Data Reduction, Validation and Reporting

Upon completion of chemical analysis, the laboratory will use the peer review process to detect errors in the analytical data package. All Lefthand field and analytical data will then be reviewed by the field team leader, the QA officer, and the laboratory senior chemist before it is presented to the EPA project manager. Decisions to reject or qualify data will be made by the senior chemist or QA officer.

Region VIII standard report forms will be used for all analyses. All data and significant observations during analyses will be noted in the final data package and will be kept on file at the EPA Region 8 Laboratory. Any deviations from the required analytical procedures will also be documented. Stream flow measurements will occur during the same general time period that the surface water samples are collected only if conditions allow safe access.

9.2 Validation and Verification Methods

Procedures to be used for validating and verifying data are as follows: comparing computer entries to field data log sheets, looking for data gaps, analyzing quality control data such as chain of custody information, spikes, equipment calibration, checking calculations, examining raw data for outliers, reviewing graphs and tables. If any of the data are found outside the QC limits identified in Table 7.0, re-analysis of the samples may be requested. Laboratory QC data will be reviewed to ensure that all data are useable.

Errors in data entry will be corrected. Outliers and inconsistencies will be flagged for further review, or discarded. Problems with data quality will be discussed in the draft and final reports.

9.3 Reconciliation with Data Quality Objectives

As soon as possible after this sampling event, calculation and determinations for precision, completeness, and accuracy will be made and corrective action implemented if needed. If data quality indicators do not meet this project's specifications, data may be discarded and resampling may occur. The cause of failure will be evaluated. If the cause is found to be equipment failure, calibration/maintenance techniques will be reassessed and improved. If the problem is found to be sampling team error, team members will be retrained. Any limitation on data use will be detailed in both draft and final reports.

If failure to meet project specifications is found to be unrelated to equipment, methods, or sample error, specifications may be revised for future sampling events.

10.0 Documentation and Reporting

Field Notes
Field notes will include a chronological record of daily sampling events and sampling information to document the critical project information. This may include:

- Project Team Members and responsibilities
- Arrival time to location(s)
- Weather conditions
- Sample identification, location, and description;
- Sampler's name;
- Date and time of collection;
- Field instrument readings;
- Physical characteristics of the samples or the area from which collected;
- Field observations and details related to integrity of samples or laboratory analysis
- Deviations from sampling plan and why;
- Applicable health and safety information or issues

10.1 Sample Location Documentation

Records of actual sampling locations and procedures will be documented through keeping a field logbook, photographs, and use of a Global Positioning System (GPS) instrument. Locations will also be mapped. Due to unanticipated conditions, site locations or procedures may change. Any deviations in locations or procedures will be documented in the field logbook and discussed with the team members at the conclusion of each day's activities.

10.2 Data Reduction, Validation and Reporting

The results of the analyses conducted by Region VIII's laboratory, including raw data sheets, QA/QC report, and a summary of the data, will be forwarded to Kathryn Hernandez, Project Manager, Region 8 EPA. The laboratory will also provide the data in electronic format to Kathryn Hernandez in the form of a Excel spreadsheet. If any laboratory QA/QC does not meet the EPA Region VIII Laboratory acceptance criteria, Bill Schroeder will be immediately notified for further instructions. The results of the water chemistry and flow data will be evaluated and summarized by TMS personnel. Data validation for chemical analyses conducted by Region VIII will follow standard operating procedures

10.3 Internal QC Checks and Frequency

Duplicate sample(s) will be collected from surface water and sent to the laboratory for metals and anion analyses. Set(s) of field blanks (container, preservation and filter) from a surface water sampling location will also be collected to check on the sample container, filtration apparatus and acids used in preservation. Blanks will be prepared from ultra-pure deionized water that has been brought into the field from the laboratory. Blanks will be prepared in the same manner as typical samples under the same environmental conditions

10.4 Preventative Maintenance

Field meter supplies including filling and buffer solutions will be changed prior to the sampling event. All field meters will be checked in the laboratory prior to the sampling event and maintenance procedures will be followed when problems are noted. In the event that maintenance procedures are unable to fix the problem, probes or parts will be replaced as needed

10.5 Schedule

The following is a preliminary schedule for this field event. The schedule will be flexible and may change by events that occur in the field.

May 17 1) Travel from the EPA Golden Laboratory to the Boulder, Colorado. EPA Laboratory personnel will provide two pickup trucks that can seat the 2 laboratory personnel plus 3 volunteers. If you desire to ride in either of the two vehicles, please contact Bill Schroeder at 303-312-7755. Each vehicle will be gassed and equipped with maps and walkie talkies. Planned departure from the EPA Lab will be 8:00 AM.
2) Unload personal gear, prepare personal field gear, brief the field team, ready trucks for field sampling, calibrate meters.

May 18 1) Calibrate field meters, load personal field gear, meet USFS parking lot at 28th and Yarmouth. Divide into teams. Team leaders will be as follows:

TEAM 1: TBD
TEAM 2: Bill Schroeder (team lead)
TEAM 3: TBD

2) Sample sites. The sites each team is responsible for sampling are listed in Table 1 of this sampling plan.
3) Debrief the field team at the end of the day. Discuss problems encountered, sites not sampled, etc.

May 19 1) Same tasks as April 18. Sample remaining sites.

10.6 Health and Safety Plan

All personnel involved in this study have current health and safety training certifications and are participating in the EPA medical monitoring program. All personnel have been trained in field safety, first aid, CPR, and laboratory safety. It is anticipated that all fieldwork can be conducted in Level D personal protective equipment (PPE). A project-specific Health and Safety Plan will be developed and reviewed by all team members prior to mobilization. Each field team will carry a copy of the project-specific Health and Safety Plan throughout the duration of the project.

Table 6-1. Proposed Lefthand Watershed Monitoring Sites

Site ID#	Description	Latitude/Longitude	Rationale	Notes
Lefthand Creek and tributaries				
5560*	Nugget Hill Mine		Drainage from mine	Gully west of Nugget Gulch
5560*	Shneider Propery – mine opening into garage		Water drainage	Near Glendale Gulch
5560*	Gale Mine and Up Gulch		Mine drainage	Only flows before July
5560A1	Lefthand Creek at Peak-to-Peak Hwy	40 04 09.27 105 31 00.66	Background reference	ACU sample site 1. Benthic/sediment sample site, also.
5560A6	Upstream of unnamed trib that drains mine across P-to-P Hwy	40.06527 N 105.51326 W	Metals from mine site (unknown name)	At CU sample site 6
5560A-TC	Tributary C below Dew Drop tails	40 03 52.77 105 30 55.95		
5560A8	Downstream of unnamed trib that drains mine across P-to-P Hwy	40.06476 N 105.51185 W	Metals from mine site (unknown name)	At CU sample site 8
5560A12	Upstream of Big Five Tunnel site	40.06288 N 105.51053 W	Metals from Big Five Tunnel site	At CU sample site 12
5560A13	Upstream of Big Five Tunnel drainage confluence	40.06228 N 105.50967 W	Metals from Big Five Tunnel site	At CU sample site 13
5560ABF1	Big Five Tunnel drainage	40.06185 N 105.50899 W	Metals from Big Five Tunnel Site	At Big Five Tunnel discharge confluence with Lefthand Creek
5560A14	Downstream of Big Five Tunnel drainage confluence	40.06192 N 105.50876 W	Metals from Big Five Tunnel site	At CU sample site 14
5560A17	Upstream of White Raven site	40.06068 N 105.50694 W	Metals from White Raven site	At CU sample site 17
5560A21	Downstream of White Raven site	40.05885 N 105.50609 W	Metals from White Raven site	At CU sample site 21
5560A-PU	Puzzler Gulch	40.05562 N 105.50183 W	Major tributary to Lefthand	CU sampling showed this trib to be clean
5560A54	Downstream of Puzzler Gulch confluence	40.05551 N 105.50160 W	Potential for dilution from Puzzler	At CU sample site 29
5560A-IN	Indiana Gulch	40 03 21.74 105 30 04.37	Major tributary to Lefthand, drains Ward mine workings	CU sampling showed some elevated metals in this trib
5560A56	Downstream of Indiana Gulch confluence at Sawmill Road.	40 03 20.81 105 30 02.47	Metals from Indiana Gulch	At CU sample site 30. Benthic/sediment sample site, also.

5560ASPRI	Spring Gulch	40 04 29.32 105 25 10.52	Tributary to Lefthand	
5560A92	Downstream of Spring Gulch	40 04 28.54 105 25 07.80	Effects of Spring Gulch	CU sample site LH2 C
5560ALI	Lick Skillet Gulch	40 04 27.27 105 24 46.66	Effects of Lick Skillet Gulch	
5560A-95-1	Above Lick Skillet and below tailings	40 04 27.77 105 24 47.33		
5560A96	Below Lick Skillet	40 04 27.69 105 24 43.82	Metals from Lick Skillet Gulch	CU sample site 15. Also a benthic/sediment sample site.
5560A101	Above Slide Mine	40 04 28.60 105 24 02.98	Metals from Slide Mine	CU sample site LH2 21 Also a benthic/sediment sample site.
5560A-SL-1	Upstream Slide Mine discharge	40 04 28.17 105 23 59.39		
5560A-SL-2	Downstream Slide Mine discharge	40 04 28.02 105 23 59.39		
5560A103	Below Slide Mine	40 04 29.70 105 23 53.08	Metals from Slide Mine	CU sample site LH2 22. Also a benthic/sediment sample site.
5560A113	Below Rowena	40 04 43.50 105 23 01.54	Metals from old workings near Rowena	CU sample site LH3 4
5560A???	Above Glendale Gulch	40.08124 N 105.36906 W	Metals from workings along Glendale Gulch	CU sample site LH3 8
5560AGG	Glendale Gulch	40.0806288 N* 105.3660441 W*	Tributary to Lefthand	*approximate coordinates. Not previously sampled by CU (dry in 2003)
5560A???	Below Glendale Gulch	40.08263 N 105.36595 W	Metals from workings along Glendale Gulch	CU sample site LH3 10
5560A???	Above Nugget Gulch	40.08816 N 105.36378 W	Metals from workings along Nugget Gulch	CU sample site LH3 13
5560ANG	Nugget Gulch	40 05 19.73 105 21 48.84	Tributary to Lefthand	*approximate coordinates. Not previously sampled by CU (dry in 2003)
5560A123	Below Nugget Gulch	40 05 20.04 105 21 46.95	Metals from workings along Nugget Gulch	CU sample site LH3 14
5560A???	Above “Lee Hill Gulch”	40.09233 N 105.35279 W	Metals from Lee Hill Gulch	CU sample site LH3 19. Also a benthic/sediment sample site.
5560ALE	“Lee Hill Gulch”	40 05 36.13 105 21 03.94	Tributary to Lefthand	

5560A129	Below "Lee Hill Gulch"	40 05 35.69 105 21 02.18	Metals from Lee Hill Gulch	CU sample site LH3 20. Also a benthic/sediment sample site
5560A???	Above James Creek confluence	40.10053 105.34277	Metals from James Creek	CU sample site LH3 27. Also a benthic/sediment sample site
5560A???	Below James Creek confluence	40.10282 N 105.34033 W	Metals from James Creek	CU sample site LH3 32. Also a benthic/sediment sample site.
5560ATI	Tributary between LH4 10 and LH4 11 sample sites. "Unnamed Trib I"	40.1087646 N* 105.3354900 W*	Ephemeral tributary to Lefthand	*approximate coordinates. Not previously sampled by CU (dry in 2003)
5560A???	Downstream of 10/11 tributary	40.10883 N 105.33517 W	Effects of 10/11 trib	CU sample site LH4 11
5560AJE	"Jeep trail" tributary	40.10656 N 105.32175 W	Effects of "Jeep trail" tributary	
5560A127	Downstream of "Jeep trail" tributary	40 06 31.77 105 19 05.67	Effects of "Jeep trail" tributary	CU sample site LH4 22
5560A136-2	½ upstream of Carnage Canyon	40 06 15.61 105 20 16.19		
5560ASI	Sixmile Creek	40.11087 N 105.30696 W	Effects of Sixmile Creek	
5560A???	Downstream of Sixmile Creek	40.11014 N 105.30635 W	Effects of Sixmile Creek	CU sample site LH4 32
5560A???	At Buckingham Park	40.11113 N 105.30704 W	Downstream of major known metal and sediment inputs	CU sample site LH4 33. Also a benthic/sediment sample site.
5560ASPRU	Spruce Gulch	40.12448 N 105.30508 W	tributary to Lefthand	
5560A???	Downstream of Spruce Gulch	40.12491 N 105.30467 W	Effects of Spruce Gulch	CU sample site LH5 11
5560A184	At Haldi Headgate	40 07 53.07 105 17 33.11	Downstream of major known metal and sediment inputs	CU sample site LH5 18. Also a benthic/sediment sample site.

Site Id	James Creek Site	Latitude/Longitude	Rationale	Notes
James Creek				
5561A62	James Creek upstream of Lefthand	40 06 07.94 105 20 33.31	Major tributary to Lefthand	
5561AT1	James Creek at Peak-to-Peak Hwy	40 05 21.33 105 29 46.75	Background reference	Colleen has done pebble counts here* CU has not sampled here.
5561AT2	Below Co. Rd. 100 crossing over James Creek	40 05 31.25 105 29 09.56	Sedimentation from vehicle travel	Colleen has done pebble counts here. CU has not sampled

				here.
5561AT3	Above Forget-Me-Not meadow	105 25 59.3 40 05 57.57	Background reference site # 2	Colleen has done pebble counts and benthic studies here. CU has not sampled here.
5561AT4	Above the Creek Crossing	40 06 04.78 105 25 47.83	Sedimentation from vehicle travel (reference)	Colleen has done pebble counts here. CU has not sampled here.
5561A-1	Below the Creek Crossing	40 0607.77 105 2546.42	Sedimentation from vehicle travel	Colleen has done pebble counts and benthic studies here. This is also upstream of the Fairday.
5561A10	Below the Fairday Mine Site	40 0638.40 105 2514.35	Metals, sedimentation from Fairday mine workings	Colleen has done pebble counts and benthic studies here. USFS has also done pebble counts here.
5561AT5	Above Gary's campsite	40 06.704 N 105 24.802 W		Colleen has done pebble counts here*.
5561A16	Above Treatment Plant where gullies from Bueno Mt. enter stream	105 24 03.13 40 06 50.24	Metals, sedimentation from Bueno Mt. mine workings	
5561A28	Jamestown Water Treatment Plant	40 06 54.86 105 23 31.55		Colleen has done pebble counts here*
5561A29	Immediately upstream of Little James confluence	40 06.981 105 23.461	Metals, sedimentation from Little James	
5561A30-582	Immediately downstream of Little James confluence	40 06 55.75 105 23 18.86	Metals, sedimentation from Little James	
5561A37	At Town Park	40 06.799 105 22.840	Metals (particularly Pb)	
5561A52	Upstream of Curie Springs	40 06.590 105 21.529	Metals	
5561A53	Just downstream of Curie Springs	40 06 34.34 105 21 29.95	Metals	
5561A-CU	Curry Springs	40 06 34.53 105 21 33.40		
5561A55a	Upstream of Castle Gulch	40 0628.45 105 22 22.16	Metals, sedimentation from Castle Gulch	
5561AHI	Hill Gulch	40 06 46.76 105 22 46.47		
5561ACG	Castle Gulch	40 06 26.36 105 21 11.79	Metals, sedimentation from Castle Gulch	*approximate coordinates
5561A56	downstream of Castle Gulch	40 06.435 105 21.119	Metals, sedimentation from Castle Gulch	

5561A62	James Creek@ Buckingham Park	40 06 07.94 105 20 33.31	Major tributary to Lefthand	
	Little James Creek Site	**Rationale**	**Notes**	
Little James Creek				
5562A-0	Little James Creek background	40 08 12.19 105 24 41.57	Background reference	
5562A-6	Upstream of Argo and small tailings			
5562A-8	Upstream of Argo below small tailings	40 07 44.75 105 24 06.99		
5562A10	Downstream of Argo discharge, upstream of Emmit	40 07 42.02 105 24 01.91		
5562A15	Upstream of Burlington Mine, downstream of Emmit	40 07 34.91 105 23 55.13	Metals, sedimentation from Emmit Adit and Balarat Creek (reference)	
5562A14	Just upstream of Emmit Adit	40.12665 105.39925	Metals, sedimentation from Emmit Adit and Balarat Creek	
5562AEM	Emmit Adit	40 07 35.30 105 23 56.97		
5562A15	Just upstream of Balarat Creek confluence	40 07 34.91 105 23 55.13	Metals, sedimentation from Emmit Adit and Balarat Creek	
5562ABA	Balarat Creek	40 07 35.32 105 23 54.41		
5562A16	Just downstream of Balarat Creek confluence	40 07 33.74 105 23 54.61	Metals, sedimentation from Emmit Adit and Balarat Creek	
5562A18-1	upstream of JRT TAILINGS	40 07 27.03 105 23 52.35	Metals from undetermined source (tailings, also ephemeral trib)	
5562A-21	Downstream of JRT tailings	40 07 24.99 105 23 50.84		
5562A28	Upstream of Streamside Tailings	40 07 11.52 105 23 39.14	Metals, sedimentation from Streamside Tailings, Bueno Mt.	
5562A29	Along Streamside Tailings	40.11941 105.39414	Metals, sedimentation from Streamside Tailings, Bueno Mt.	
5562A32	Downstream of Streamside Tailings	40 07 04.02 105 23 38.08	Metals, sedimentation from Streamside Tailings, Bueno Mt.	
5562A35	Bottom of Waterfall	40.11674 105.39215		
5562A38	Just above confluence with Little James	40 06 58.41 105 23 28.35		

Table 6-2a: General description of analytical services requested for May 2004 sampling

MATRIX	ANALYSIS (method)	NO. OF SAMPLES (without QC)	QC SAMPLES
Water	Field Parameters: pH, DO, conductivity, temperature, flow, and GPS, turbidity	78	
Water	Total Recoverable Metals (EPA 200.7)	78	4
Water	Dissolved Metals (EPA 200.7)	78	4
Water	Lithium (EPA 200.8)	150	6
Water	Anions: TP, SO_4 (EPA 300)	39	2
Water	TSS, DOC, TUR	39	2
Sediment	Total Recoverable Metals	78	4
Water	Macroinvertebrates (Rapid Bioassessment Protocols)	10	
Sediment	Habitat Assessment (Rapid Bioassessment Protocol) and particle distribution	10	

Table 6-2b: General description of analytical services requested for November 2004 sampling

MATRIX	ANALYSIS (method)	NO. OF SAMPLES (without QC)	QC SAMPLES
Water	Field Parameters: pH, DO, conductivity, temperature, flow, and GPS, turbidity	78	
Water	Total Recoverable Metals (EPA 200.7)	78	4
Water	Dissolved Metals (EPA 200.7)	78	4
Sediment	Total Recoverable Metals	78	4
Macroinv.	Tissue Analysis – TR Metals	50	
Fish Tissue	Tissue Analysis – TR Metals	25	

Site ID#	Description	Field Measurement	Chemical Samples						Biological sampling		Habitat analysis
			Water					Sediment			
		Flow, pH, DO, temp	**DOC**	**Tur, TSS, SO4**	**Total Metals**	**Diss. Metals**	**TP,**	**Total Metals (#)**	**Tissue Analysis**	**Species Comp.**	**RBA protocols + Beringer / King, Particle size distr**
5560A-1	Lefthand Creek at Peak-to-Peak Hwy	5, 11	5	5	5, 11	5, 11	5	5, 11	11	5	**5** (ref)
5560A-TC	Trib C off the peak to peak turn off right before	5, 11			5, 11	5, 11		5, 11			
5560A-PU	Puzzler Gulch	5, 11			5, 11	5, 11		5, 11			
5560A-51	Lefthand above Puzzler confl	5, 11			5, 11	5, 11		5, 11			
5560A-54	Lefthand below Puzzler above Ind	5, 11			5, 11	5, 11		5, 11			
5560AIN	Indiana Gulch	5, 11			5, 11	5, 11		5, 11	11		
5560A-56 ~~(A29)~~	Downstream of Indiana Gulch confluence at Sawmill Road.	5, 11	5	5	5, 11	5, 11	5	5, 11	11		USFS bugs site above Indiana. Almost sterile. (particle size distribution only)
5560A-69-1	Directly below Loader Smelter in LH	5, 11			5,11	5, 11		5, 11			
5560A-63a ~~(A41*)~~	Downstream of Tuscarora Gulch Below Loader Smelter	5, 11	5	5	5, 11	5, 11	5	5, 11	11		USFS bugs site – by picnic site (near 69)
5560A-SPRI	Spring Gulch	5, 11			5, 11	5, 11		5, 11	11		Good population – diversity ?
5560A-92 ~~(A64)~~	Downstream of Spring Gulch	5, 11			5, 11	5, 11	5	5, 11	11		
5560A-95-1	Above Lickskillet below tailings	5, 11	5	5	5, 11	5, 11	5	5, 11		5	**5**
5560ALI	Lick Skillet Gulch	5, 11		5	5, 11	5, 11		5, 11	11		

Site ID#	Description	Field Measurement	Chemical Samples						Biological sampling		Habitat analysis
			Water					Sediment			
		Flow, pH, DO, temp	DOC	Tur, TSS, SO4	Total Metals	Diss. Metals	TP,	Total Metals (#)	Tissue Analysis	Species Comp.	RBA protocols + Beringer / King, Particle size distr
5560A-96 ~~(A67*)~~	Below Lick Skillet Rd.	5, 11		5	5, 11	5, 11	5	5, 11			
5560A-101 ~~(A73)~~	Above Slide Mine	5, 11		5	5, 11	5, 11	5	5, 11			
5560ASL1	At Slide Mine downstream discharge	5, 11			5, 11	5, 11		5, 11			
5560ASL2	At slide Mine upper discharge	5, 11			5, 11	5, 11		5, 11			
5560A-103 ~~(A74)~~	Below Slide Mine	5, 11		5	5, 11	5, 11	5	5, 11			
5560A-113 ~~(A84)~~	Below Rowena	5, 11		5	5, 11	5, 11	5	5, 11			
5560ANG	Nugget Gulch	5, 11			5, 11	5, 11		5, 11			
5560A123 ~~(A94)~~	Below Nugget Gulch	5, 11		5	5, 11	5, 11	5	5, 11			
5560ALE	"Lee Hill Gulch"	5, 11			5, 11	5, 11		5, 11			
5560A-129 ~~(A100)~~	Below "Lee Hill Gulch"	5, 11		5	5, 11	5, 11	5	5, 11	11		
5560A-127 ~~(A127*)~~	Below 4WD at Carnage Canyon	5, 11	5	5	5,11	5,11		5,11		no	Particle size distribution only USFS site (Uof C #156)
5560A-136-2 ~~(A108*)~~	Below James Creek confluence	5, 11		5	5, 11	5, 11	5	5, 11	11		
5560A-184 ~~(A154)~~	At Haldi Headgate	5, 11	5	5	5, 11	5, 11	5	5, 11	11	5	**5**
5561A-T1	James Creek at Peak-to-Peak Hwy	5, 11	5		5, 11	5, 11	5	5, 11	11	5	**5 (ref)**

Site ID#	Description	Field Measurement	Chemical Samples						Biological sampling		Habitat analysis
			Water					Sediment			
		Flow, pH, DO, temp	DOC	Tur, TSS, SO4	Total Metals	Diss. Metals	TP,	Total Metals (#)	Tissue Analysis	Species Comp.	RBA protocols + Beringer / King, Particle size distr
5561A-T2	Below Co. Rd. 100 crossing over James Creek	5, 11	5	5	5, 11	5, 11	5	5, 11	11	5	**5**
5561A-T3	Above Forget-Me-Not meadow	5, 11	5	5	5, 11	5, 11	5	5, 11	11	5	**5(ref)**
5561A-T4	Above the Creek Crossing	5, 11	5	5	5, 11	5, 11	5	5, 11	11	5	**5**
5561A-1	Below the Creek Crossing	5, 11	5	5	5, 11	5, 11	5	5, 11	11		Above John Jay
5561A-10	Below the Fairday Mine Site	5, 11	5	5	5, 11	5, 11	5	5, 11	11		
5561A-FD	Trib from Fairday	5, 11	5	5	5, 11	5, 11	5	5, 11			
5561A-16	Above Treatment Plant where gullies from Bueno Mt. enter stream	5, 11	5	5	5, 11	5, 11	5	5, 11	11		
5561A-28	Jamestown Water Treatment Plant	5, 11	5	5	5, 11	5, 11	5	5, 11	11	5	**5**
5561A-30-582	downstream of Little James confluence	5, 11	5	5	5, 11	5, 11	5	5, 11	11	5	**5 – Riverwatch site**
5561A-HI	Hill Gulch above Elsian Park	5, 11			5, 11	5, 11		5, 11			
5561A-55A	James Creek below Jenks Gulch	5, 11	5	5	5, 11	5, 11	5	5, 11	11		USFS site
5561A-53	Just downstream of Curie Springs	5, 11			5, 11	5, 11	5	5, 11	11		
5561A-CU	Curie Gulch Adit (small bldg)	PH only			5, 11			5, 11	11		
5561ACG	Castle Gulch	5, 11		5	5, 11	5, 11		5, 11	11		

Site ID#	Description	Field Measurement	Chemical Samples						Biological sampling		Habitat analysis
			Water					Sediment			
		Flow, pH, DO, temp	DOC	Tur, TSS, SO4	Total Metals	Diss. Metals	TP,	Total Metals (#)	Tissue Analysis	Species Comp.	RBA protocols + Beringer / King, Particle size distr
5561A-62	downstream of Castle Gulch	5, 11		5	5, 11	5, 11	5	5, 11	11		
5562A-0	Little James Creek above the Argo Mine	5, 11	5	5	5, 11	5, 11	5	5, 11	11	5	**5 ref**
5562A-6	Little James above small tailings & Argo (green gate) at road				5, 11	5, 11		5, 11			**NOT GPSd**
5562A-8	Above Argo Mine below tailings	5, 11		5	5, 11	5, 11		5, 11	11		Source sedm samples
5562A-10	Upstream of Burlington Mine below Argo	5, 11		5	5, 11	5, 11		5, 11	11		
5562A-EM	Emmit Adit	5, 11			5, 11	5, 11		5, 11	11		Source and sediment samples @ adit
5562A-15	upstream of Balarat Creek below Emmit	5, 11		5	5, 11	5, 11		5, 11	11		
5562ABA	Balarat Creek	5, 11			5, 11	5, 11		5, 11	11		
5562A-16	downstream of Balarat Creek confluence	5, 11		5	5, 11	5, 11		5, 11	11		
5562A18-1	Above JRT tailings after Fork	5, 11		5	5,11	5, 11		5, 11	11		
5562A-21 ~~(A22)~~	Below JRT tailings in Little James	5, 11		5	5, 11	5, 11		5, 11	11		Source and sediment samples
5562A-28 ~~(A25)~~	Upstream of Streamside Tailings	5, 11		5	5, 11	5, 11	5	5, 11	11		
5562A-32 ~~(A31)~~	Downstream of Streamside Tailings	5, 11		5	5, 11	5, 11		5, 11	11		

Site ID#	Description	Field Measurement	Chemical Samples						Biological sampling		Habitat analysis
			Water					Sediment			
		Flow, pH, DO, temp	DOC	Tur, TSS, SO4	Total Metals	Diss. Metals	TP,	Total Metals (#)	Tissue Analysis	Species Comp.	RBA protocols + Beringer / King, Particle size distr
5562A-38	Just above confluence with James	5, 11	5	5	5, 11	5, 11	5	5, 11	11	**5**	**5** (sterile)
Totals	55 sites		20 sampl es	37 samples	85 (incl source samples	85 (incl source samples	30 sampl es	85 sedm samples (incl source)		Species compositi on - 10	Habitat ass = 10 Particle size = 11

Source Analysis Site Name	Background Soils	Source Tails	Elutriation
Argo	5	5	5
Bueno	5	5	5
Emmit	5	5	5
Fairday	5	5	5
Golden Age Mine	5	5	5
Grand Central	5	5	5
JRT	5	5	5
Loader	5	5	5
Burlington Tails	11	11	11
Lick Skillet	11	11	11
Dew Drop	11	11	11
Totals	**5 – 8 sites**		

TABLE 6-4 ESAT MDL – ICP MS

2004	MDL	CCV	ICV	ICSA	ICSAB	CRA	Spike	LCS	Units
Be 9	1	50	50	0.0	0.0	2	50	1000	ug/L
Al 27	10	50	50	10000	10000	20	2000	1000	ug/L
V 51	3	50	50	0	0	12	200	1000	ug/L
Cr 52	2	50	50	0.0	20.0	10	200	1000	ug/L
Mn 55	2	50	50	0.0	20.0	2	200	1000	ug/L
Co 59	0.2	50	50	0.0	20.0	1	200	1000	ug/L
Ni 60	0.4	50	50	0.0	20.0	1.5	200	1000	ug/L
Cu 65	5	50	50	0.0	20.0	10	200	1000	ug/L
Zn 66	3	50	50	0.0	20.0	10	500	1000	ug/L
As 75	1	50	50	0.0	20.0	5	100	2000	ug/L
Se 82	1	50	250	0.0	0.0	5	50	1000	ug/L
Mo 98	0.2	50	50	0.0	0.0	1	0	1000	ug/L
Ag 107	0.2	50	50	0.0	20.0	1	50	250	ug/L
Cd 114	0.2	50	50	0.0	20.0	1	50	1000	ug/L
Sb 121	0.5	50	50	0.0	0.0	10	200	2000	ug/L
Ba 135	0.3	50	50	0.0	0.0	2	500	1000	ug/L
Hg 202	0.5	2.5	0	0.0	0.0	2	0	0	ug/L
Tl 205	0.1	50	50	0.0	0.0	1	50	5000	ug/L
Pb 208	0.3	50	50	0.0	0.0	1	100	2000	ug/L
Th 232	0.1	50	50	0.0	0.0	0.5	0	0	ug/L
U 238	0.1	50	50	0.0	0.0	0.5	0	0	ug/L

MDL Determined: 1/13/2004

Table 6 – 5 ESAT MDL _ICP-OE

2004	MDL	ICV	CCV	Spike	ICSA	ICSAB	CRA	LCS	Cal Std	Range
Al3961	0.02	0.500	5.00	2.0	60.0	60.0	0.050	1.0	10.0	250
As1890	0.005	1.000	2.50	0.80	0	1.0	0.025	2.0	5.0	10
As1937	0.005	1.000	2.50	0.80	0	1.0	0.025	2.0	5.0	10
Ba4554	0.002	0.500	0.50	0.20	0	0.30	0.010	1.0	1.0	10
Ba4934	0.002	0.500	0.50	0.20	0	0.30	0.010	1.0	1.0	10
Be3130	0.001	0.500	0.50	0.20	0	0.10	0.005	1.0	1.0	10
Ca3158	0.05	0.500	0.50	0.20	0	0.10	0.250	1.0	1.0	1000
Ca3179	0.05	2.500	10.00	1.0	300	300	0.250	1.0	20.0	1000
Co2286	0.001	0.500	0.50	0.20	0	0.30	0.005	1.0	1.0	10
Cr2677	0.001	0.500	2.50	0.40	0	0.30	0.005	1.0	5.0	10
Fe2382	0.05	2.500	5.00	3.0	250	250	0.150	1.0	10.0	600
Fe2599	0.05	2.500	5.00	3.0	250	250	0.150	1.0	10.0	600
K_7664	0.2	5.000	10.00	10	0	20.0	1.000	5.0	20.0	330
Mg2790	0.2	2.500	10.00	2.0	150	150	0.500	1.0	20.0	1000
Mn2605	0.005	0.500	1.00	0.20	0	0.20	0.025	1.0	2.0	400
Mo2020	0.002	0.500	0.50	0.4	0	0.3	0.010	1.0	1.0	50
Na5889	0.1	2.500	10.00	3.0	50.0	50.0	0.500	1.0	20.0	1000
Ni2216	0.002	0.500	2.50	0.50	0	0.30	0.010	1.0	5.0	50
Sb2068	0.005	1.000	1.00	0.80	0	1.0	0.025	2.0	2.0	5
Se1960	0.01	0.500	2.50	2	0	0.5	0.040	1.0	5.0	10
SiO2-2516	0.05	2.500	5.00	2	0	0.5	0.250	5.0	10.0	50
Tl1908	0.01	2.500	2.50	2	0	1.0	0.050	5.0	5.0	10
V_2924	0.005	0.500	1.00	0.3	0	0.3	0.015	1.0	2.0	10

all units = mg/L Method = IntStd3 MDL determined 1-12-04

Table 6-6. EPA Region 8 Laboratory Analyses:

Analyte (Specific)	Prep/ Analytical Methods	Reporting Limits (RL)	Container	Preservative	Hold Time
Anions					
Sulfate (SO4)	EPA 300.0 SOP 310	1.0 mg/L	1 L HDPE cubitainers	Chill < 4 °C	28 days
Wet Chemistry Inorganics					
Turbidity (Tur)	EPA 180.1 SOP 307	N/A	1 L HDPE cubitainers	Chill < 4 °C	48 hours
Solids					
Total dissolved solids (TDS)	EPA 160.1 SOP 304	4 mg/L	1 L HDPE cubitainers	Chill < 4 °C	7 days
Total suspended solids (TSS)	EPA 160.2 SOP 303	4 mg/L	1 L HDPE cubitainers	Chill < 4 °C	7 days
Nutrients					
Total phosphorous (TP)	I-4600-85 SOP 320	0.02 mg/L	1 L HDPE cubitainers	Chill < 4 °C, H_2SO_4, pH < 2	28 days

Table 7: Metals QC Check Protocol for ICP, ICP-MS, and GFAA (Each Run)

QC Check (Symbol)	Explanation	Run Frequency	Acceptance Criteria	Corrective Action
Quality Control Sample (ICV)	Preferably out-of-house, critiqued standard or else standard from different lot than calibration standards	Beginning of run to verify calibration; it may also take place of last CCV	Published limits or 90-110% of "true" (ICP & DW AA); 85-115% (AA) otherwise	Restandardize & rerun ICV
Continuing Calibration Verification (CCV)	Approximate mid-range std made from working stds stock	Every 10 samples and at end	90-110% expected	Restandardize & rerun all samples from last “acceptable” QC or check sample
Spectral/Mass Interference Check for ICP/ICP-MS (SIC/ICS)	Challenge each channel or line with a potential spectral or mass interferent	Once/run beginning or end	For SIC's with analytes (100 ±20% expected); otherwise ≤± PQL for SIC & ICS	Recalculate IEC’s & rerun SIC or use an alternate wave-length Recalc mass eqns for ICS & rerun
Calibration Blank (CB)	Blank with same acid content as working stds; i.e. zero point on curve	Beginning, end and after each CCV	≤± PQL	Restandardize on So
Preparation Blank (PB)	Digested or extracted blank with same reagents as prepared unknowns	Once/run or 5% - whichever greatest	≤ PQL	Redigest all samples <10 times PQL value
Matrix Spike (SPK)	Unknown sample fortified at 10-100 X MDL for each analyte; for high conc. samples (spike <20% analyte conc.), no calc. required	Every 10th sample for drinking waters (DW), otherwise 1 per 20 unknown	Spike recovered at: 75-125% (AA) 80-120% (ICP & ICP-MS) waters, 65-135% (both) solids	Check for instrument drift. Compose 1 post-digest spike & retest. If still not acceptable, see corrective action for L.
Lab Fortified Blank (LFB)	Spike of CB at same level as SPK	Once/run for DW samples	85-115% expected	Same as for Matrix Spike
Duplicate Sample (DUP)	Either a field split or lab aliquot of previous sample	1 per 20 unknown	≤20% RSD for conc, ≥PQL except for solid matrices (≤35%)	Check for instrument drift, noise, sample in homogenity or contamination prior to re-preparation
Lab Control Sample (LCS)	For solid & liquid digested matrices, a well-characterized known prepared same as unknowns and of similar matrix	1 per batch	80-120% of "true" value or published limits, waters 70-130% of “true” value, solids	Check for corresponding high or low results in pre-digest spikes, if similar, redigest all samples
Serial Dilution (L) for ICP & ICP-MS	Unknown whose conc. ≥50 MDL diluted 5 X	1 per batch	Dilution value 90-110% of original for waters, 80-120% solids	Dilute all samples not near RL or run by std. additions
Detection Limit Standard (DET)	Low level standard ≈ 2-5 MDL conc.	Once/batch prior to unknowns; run only when sens criteria failed during standardization e.g. Mo or IR’s	50-150% of expected	Correct instrument's sens. problem or else need to redetermine & raise reporting limits

NOTE: Calibration is to be performed daily; corr. coeff. must be ≥ 0.995. When sample values >PQL, replicate RSD must be ≤ 20%. MDLs and linear ranges are to be redetermined annually. A PE sample must be passed yearly. (1) Additional acceptance requirements for tuning soln. and I.S. drift

APPENDIX A2
Lefthand Watershed Collaborative Sampling
Quality Assurance Project Plan

Quality Assurance Project Plan
for the
Chemical and Biological Assessment of the Left Hand Watershed
Spring high flow and Fall low flow 2004-2005

Prepared By:

Kathryn Hernandez
EPA Region VII
999 18th Street
Denver, CO 80202

March 5, 2004

APPROVALS:

______________________________________ ____________

Angus Campbell, Project Manager Date
Remedial Programs
Hazardous Materials and Waste
Management Division
Colorado Department of Public Health and Environment

______________________________________ ____________

Kathryn Hernandez, Project Manager Date
Environmental Scientist
Ecosystems Protection and Remediation
EP Office

______________________________________ ____________

Stan Christensen, RPM Date
Ecosystems Protections and Remediation
Superfund Remedial Office

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DISTRIBUTION LIST

This Sampling and Analysis Plan (SAP) and Quality Assurance Project PLan(QAPP) and any subsequent revision will be distributed to the following individuals and organizations listed below as well as anyone upon request of this document.

- Stan Christensen – Region 8 EPA – RPM
- Sabrina Forrest – Region 8 EPA – Site Assessment
- University of Colorado – Professor Joseph Ryan
- Lefthand Watershed Oversight Group (LWOG)
- Bill Schroeder – Region 8 EPA Laboratory

Section 1
Project Management and Objectives

This quality assurance project plan (QAPP) supports the surface water, groundwater, biological and sediment sampling programs for Left Hand Watershed in Boulder, Colorado. This QAPP was prepared in accordance with EPA QA/R-5 EPA Requirements for QAPPs, Final (EPA 2001) and EPA's QA/G-5 guidance for QAPPs (EPA 1998). Section 1.0 presents project management and introductory information. Section 2.0 provides guidance for measurement and data acquisition. Section 3.0 describes assessment and oversight aspects of the project, and Section 4.0 describes data validation and usability issues. References are provided in Section 5.0.

1.1 Project/Task Organization

This section covers the basic area of project management, including project organization, background and purpose, project description, quality objectives and criteria, roles and responsibilities of participants, special training, documentation and records. . The surface water, groundwater and sediment sampling program will be implemented by, Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division (CDPHE) and their consultant Walsh Environmental Scientists and Engineers (Walsh) and EPA Region VIII. University of Colorado will provide assistance collecting samples. Specific QA and sampling plans are in place for the surface water, groundwater and sediment sampling for these programs. Analytical services for the Captain Jack Superfund site will be provided by the Environmental Services Assistance Team (ESAT) contract at the EPA Region VIII laboratory, and the EPA Region VIII laboratory located at 16194 W. 45th Drive, Golden, Colorado 80403. Dr. John Gillis is the contract manager and can be reached at (303) 312-7824 or 303-312-7708. The laboratory's main number is 303-312-7700. Analytical services for the watershed wide samples will be provided Contract Laboratory Program (CLP) contract. Carol Beard is the Technical Project Officer (TPO) and can be reached at 303-312-6687. Additional analytical services to anions, TSS and turbidity will be provided by the EPA Region VIII laboratory.

1.1.1 EPA Project Managers

The EPA Remedial Project Manager (RPM) for the Captain Jack Superfund site is Mr. Stan Christensen (303) 312-6694. The EPA Project Manager for the Left Hand Watershed is Kathryn Hernandez (303) 312-6101). They have overall responsibility for the surface water and sediment sampling investigation. Mr. Christensen and Ms. Hernandez are responsible for:

- Defining project objectives
- Establishing project policy and procedures to address the specific needs of the overall project and of each task
- Granting final approval of project plans and reports generated by contractors
- Assuring that plans are implemented according to schedule
- Committing the resources necessary to meet project objectives and requirements
- Evaluating project staffing requirements and acquiring EPA or contractor resources as needed to ensure performance within budget and schedule constraints
- Informing contractor personnel concerning special considerations associated with the project
- Providing site access (if necessary)
- Reviewing work progress for each task to ensure that budgets and schedules are met
- Reviewing and analyzing overall performance with respect to goals and objectives
- Ensuring that EPA field sampling teams have the supplies and equipment needed
- Maintaining communication with the EPA Region VIII laboratory with regards to the sampling schedule, delivery orders, and sample analysis
- Maintaining communication with the EPA Region VIII laboratory about receipt of analytical results.

1.1.2 EPA Region VIII Laboratory

Dr. John Gillis is responsible for the ESAT contract and related QA/QC issues and keeping the analytical service uninterrupted. Dave Ostrander of the EPA Region VIII laboratory is responsible for the laboratory and related QA/QC issues and keeping the analytical service uninterrupted. Additional responsibilities include:

- Scheduling laboratory personnel and material resources
- Maintaining proper chain-of-custody and performing all designed analytical services
- Preparing and delivering analytical reports to the EPA RPM
- Identifying problems, resolving difficulties in consultation with QA staff, implementing and documenting corrective action procedures
- Maintaining QA/QC for the laboratory.

1.1.2.1 CLP Laboratory

- Scheduling laboratory personnel and material resources
- Maintaining proper chain-of-custody and performing all designed analytical services
- Preparing and delivering analytical reports to the EPA RPM

- Identifying problems, resolving difficulties in consultation with QA staff, implementing and documenting corrective action procedures
- Maintaining QA/QC for the laboratory.

1.1.3 University of Colorado

The U of C field team leader for activities to be performed in March, 2004 at the Left Hand Watershed Site is Dr. Joseph Ryan (303-492-0772). Alice Wood is the overall manager for the field sample collection effort and is responsible for coordination of the following activities:

- Maintaining communications with EPA regarding University of Colorado work
- Assembling and supervising University of Colorado field sampling teams
- Supervising production and review of deliverables
- Tracking work progress against planned budgets and schedules
- Scheduling personnel and material resources
- Implementing field aspects of the investigation, including this QAPP, the monitoring plan, and other project documents.

The University of Colorado field sampling team is responsible for the following:

- Notifying the EPA RPM of the delivery of samples
- Gathering sampling equipment and field logbook(s)
- Obtaining sample containers, preservatives, and forms
- Ensuring that the quantity and location of all samples meet the requirements of appropriate work plans.
- Identifying problems, resolving difficulties in consultation with QA staff, implementing and documenting corrective action procedures.
- Maintaining proper chain-of-custody forms during sampling events.

1.1.4 EPA Region VIII Field Group

EPA Region VIII Laboratory field group is responsible for:

- Organizing surface water, biological and sediment sample collection
- Working with University of Colorado and EPA staff field teams to make sure samples are collected properly and that field and chain of custody documentation is correctly performed
- Validation of project data
- Communicating with EPA RPM, CDPHE regarding project status.
- Notifying the EPA RPM of the delivery of samples
- Gathering sampling equipment and field logbook(s)
- Obtaining sample containers, preservatives, and forms
- Ensuring that the quantity and location of all samples meet the requirements of

appropriate work plans.

- Identifying problems, resolving difficulties in consultation with QA staff, implementing and documenting corrective action procedures.
- Maintaining proper chain-of-custody forms during sampling events

1.1.5 CDPHE Project Manager

The CDPHE Remedial Project Manager (RPM) for the Captain Jack Superfund site is Mr. Angus Campbell (303) 692-3385. He has overall responsibility for the surface water, groundwater and sediment sampling investigation at the Captain Jack site. Mr. Campbell is responsible for:

- Defining project objectives
- Establishing project policy and procedures to address the specific needs of the overall project and of each task
- Granting final approval of project plans and reports generated by consultants
- Assuring that plans are implemented according to schedule
- Committing the available resources that are necessary to meet project objectives and requirements
- Evaluating project staffing requirements and consultants resources as needed to ensure performance within budget and schedule constraints
- Informing consultants personnel concerning special considerations associated with the project
- Providing site access (if necessary)
- Reviewing work progress for each task to ensure that budgets and schedules are met
- Reviewing and analyzing overall performance with respect to goals and objectives
- Maintaining communication with the ESAT laboratory with regards to the sampling schedule, delivery orders, and sample analysis
- Maintaining communication with the ESAT laboratory about receipt of analytical results.

1.1.5.1 CDPHE Contractor

Walsh has been selected as the CDPHE contractor. Walsh's project manager will be determined prior to mobilization into the field. This person is responsible for the overall management and coordination of collecting surface water, sediment and biological samples from the Captain Jack area and performing all appropriate procedures for sample collection. The Walsh project manager will be responsible for:

- Maintaining communications with CDPHE regarding the site work
- Assembling and supervising project team
- Production and review of deliverables
- Tracking work progress against planned budgets and schedules
- Scheduling personnel and material resources

- Implementing all aspects of the RI/FS work plans and applicable guidance documents, including this QAPP, the monitoring plan, and other project documents.
- Notifying the CDPHE of the field work activities
- Gathering sampling equipment and field logbook(s)
- Ensuring that the quantity and location of all samples meet the requirements of appropriate work plans.
- Identifying problems, resolving difficulties in consultation with QA staff, implementing and documenting corrective action procedures.
- Maintaining proper chain-of-custody forms during sampling events.

1.1.6 Quality Assurance Organization

Responsibility for Quality Assurance for the project lies with each member of the team. However, EPA Project Coordinator, Kathryn Hernandez and RPM's Stan Christensen and Angus Campbell remains responsible for these overall project quality objectives:

- Implementing corrective actions resulting from staff observations, QA/QC surveillance, and/or QA audits
- Reviewing and approving project-specific plans
- Directing the overall project QA program
- Maintaining QA oversight of the project
- Reviewing QA sections in project reports as applicable
- Reviewing QA/QC procedures applicable to this project
- Initiating, reviewing, and following up on response actions, as necessary
- Arranging performance audits of measurement activities, as necessary.

1.1.7 Report Organization

This QAPP is organized in accordance with EPA's QA/R-5 guidance for preparing QAPPs. This section (Section 1.0) presents project management and introductory information. Section 2.0 provides guidance for measurement and data acquisition. Section 3.0 describes assessment and oversight aspects of the project, and Section 4.0 describes data validation and usability issues.

Appendix I, describes the site specific details for the Captain Jack superfund site RI/FS as they differ from this QAPP.

1.2 Background and Purpose

The Left Hand Creek Watershed covers about 85 square miles and lies in north central Colorado on the eastern slope of the front range of the Rocky Mountains, northwest of Boulder, Colorado. Many intermittent streams exist throughout the watershed; however, Left Hand, James, and Little James are the only perennial streams. The James Creek watershed covers approximately 36 square miles from its source near Ward to its confluence with Left Hand Creek. The Little James Creek watershed area only encompasses about three square miles. Little James Creek flows into James Creek, which flows drains into Left Hand Creek. Combined, the basin discharges about 28,840 acre-feet annually (EPA 2003) Over 100 years of mining in this region have resulted in heavy metal and other mining-related contamination throughout the Left Hand Creek Watershed

The Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE will coordinate environmental and water quality assessments and funding efforts within the Left Hand Watershed. This effort will promote a holistic approach to assure stakeholder coordination in establishing and achieving environmental cleanup and water quality goals. A key component of this effort will be assuring participation between local, state and federal stakeholders. Several stakeholders have collected mine waste, surface water/sediment, and ground water samples.

There were synoptic surface water quality studies and data collection efforts focused on metals in the Left Hand Watershed by University of Colorado in 2002 and 2003. The surface water quality indicated exceedances of the acute standard for zinc and copper in section of Left Hand Creek, James Creek and Little James Creek. Data collected in Little James Creek indicated exceedances of aluminum, copper, lead and zinc. Under a current 319 EPA grant, a water quality assessment report of the Left Hand Watershed is being written by the Left Hand Watershed Oversight Group (LWOG). The focus will be to summarize the most relevant current and historic water quality work in the Left Hand watershed in order to determine data needs and future sampling strategies. Sampling and analysis activities in 2004 will be conducted by the USFS, USGS, CDPHE and EPA with assistance from University of Colorado.

Left Hand Creek and Little James Creek are listed on the State of Colorado's 1998 303(d) list as impaired for not supporting the aquatic life use classification. Both waters are listed and have a high priority for Total Maximum Daily Load (TMDL) development. The listing specified that the numeric standards for cadmium, iron, manganese, zinc and pH, were not being attained. Additional dissolved metals data have shown that collected by the Division of Water Quality at CDPHE indicated that the Colorado Acute standards for copper and lead are also exceeded. The water quality in Left Hand Creek, James Creek and Little James Creek is affected by discharges from various mines and waste rock and mine tailings in the area. The drainage area encompasses the historical Captain Jack and Golden Age mining districts and receives runoff from a number of rock dumps, mill tailings and abandoned mining sites. These areas were mined for gold, lead, silver, fluorspar (calcium fluoride) and uranium.

The EPA has conducted several Superfund Pre-remedial investigations in the Left Hand Watershed. Although there are numerous mines throughout the watershed, only one mine is presently on the National Priorities List. This is the Captain Jack Mill site (CERCLIS ID COD981551427) located in the upper portion Left Hand Creek. Other mines that have been investigated through the EPA PA/SI program are the Golden Age Mine (CERCLIS ID CO0000023077), located in Little James and James Creek, the , and the Slide Mine/Corning Tunnel (CERCLIS ID CON000801995), located in the middle portion of Left Hand Creek. Site investigations have been completed at the Captain Jack, Golden Age, and the Slide Mines within the district. A remedial investigation is planned to begin at the Captain Jack Mine in FY 2004.

The purpose of the watershed sampling and analysis program is to quantify the existing load of dissolved metals, total metals in the surface water and metals concentration in sediments to assist in determining the potential sources and their contributions to the watershed.

The purpose of this QAPP is to provide guidance to ensure that all environmentally-related data collection procedures and measurements are scientifically sound and of known, acceptable, and documented quality and the sampling activities are conducted in accordance with the requirements of this project.

1.3 Project Goal

Receptors in the watershed include fisheries, wetlands, and the Left Hand Water District drinking water intake located near the mouth of Left Hand Canyon and residents that live near mine waste rock and tailings piles. The overall purpose of this sampling plan is to collect additional surface water and sediment samples at high and low flows throughout the basin in order to identify the significant loading sources of metals and to allow the stakeholders to evaluate water quality in the various drainages of the Left Hand Canyon Watershed which includes Left Hand Creek, Little James Creek and James Creek and their tributaries. This data will assist in making feasibility and remedial cleanup decisions for the watershed in an effort to meet existing water quality standards that adequately protect human health and the environment in the Left Hand Watershed

1.4 Quality Objectives and Criteria for Measurement

This section provides a means for control and review of the project so that environmentally-related measurements and data collected by the field sampling teams are of known and acceptable quality. The subsections below describe the data quality objectives (DQOs) (Section 1.4.1) and data measurement objectives (Section 1.4.2) for the project.

1.4.1 Data Quality Objectives

The DQO process is a series of planning steps based on the scientific methods that are designed to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended purpose. The EPA has issued guidelines to help data users develop Left Hand Watershed Site-specific DQOs (QA/G-4; August 2000). The DQO process is intended to:

- Clarify the study objective
- Define the most appropriate type of data to collect

- Determine the most appropriate conditions from which to collect the data
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the design.

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and ensures that analytical techniques are used that will generate the specified data quality. The process also ensures that the resources required to generate the data are justified. The DQO process consists of seven steps of which the output from each step influences the choices that will be made later in the process. These steps are as follows:

Step 1: State the problem.
Step 2: Identify the decision.
Step 3: Identify the inputs to the decision.
Step 4: Define the study boundaries.
Step 5: Develop a decision rule.
Step 6: Specify tolerable limits on decision errors.
Step 7: Optimize the design.

During the first six steps of the process, the planning team develops decision performance criteria (i.e., DQOs) that will be used to develop the data collection design. The final step of the process involves refining the data collection design based on the DQOs. A brief discussion of these steps and their application to this QAPP is provided below.

1.4.1.1 Step 1: State the Problem

Sampling by the University of Colorado and RiverWatch in 2002 and 2003 found concentration of copper and zinc in Left Hand Creek, James Creek and Little James Creek that exceed State water quality standards for dissolved metals.

Left Hand Creek
UOS (URS Operating Services) conducted field work at the Captain Jack Mill (CJM) site on June 25 and 26th, 1997. Surface water and sediment samples collected along Left Hand Creek and its tributaries on June 25 and 26, 1997, indicated elevated concentrations of aluminum, calcium, copper, iron, lead, magnesium, manganese and zinc. The Hazardous Materials and Waste Management Division (HMWMD) of the Colorado Department of Public Health and Environment (CDPHE), under a cooperative agreement with the U.S. Environmental Protection Agency (EPA), conducted a Combined Assessment if the Slide Mine/Corning Tunnel area in Fall 2003. Sediment sampled collected from Left Hand Creek downstream of the PPE for site contaminants indicate that pile materials are migrating from the site to the drainage and are present at elevated concentrations in sediments 0.3 miles downstream of the site. CDPHE also performed a high-flow sampling event on April 18, 2003. Field observations made on this sampling date indicated that the site was discharging to Left Hand Creek.

The Left Hand Water District experiences ongoing problems with sediment deposition related to several off road vehicle areas, at their intake on Left Hand Creek. This District has spent hundreds of thousands of dollars recently in efforts to mitigate the impact of these sediments. The District spends many man and equipment hours each year removing sediment from their intake structures.

There are potential nutrient loading concerns from the cumulative impact of Individual Sewage Disposal Systems (ISDS).

James Creek
The Golden Age Mining district contributes runoff to James Creek. Jenks Gulch, Castle Gulch, Hill Gulch and other drainages may be contributing additional metals to James Creek. Flat Creek may be impaired due to excessive nutrient and sediment levels. Additional data are needed to further diagnose these potential impairments. Indications are that metals are not impacting James Creek upstream of Little James Creek. Metals concentrations at these sites were often below detection. An ecological investigation of the water quality of the upper James Creek (Duren, 2001) found that roads and off road vehicle activity may have had a negative affect on the ecosystem health of James Creek.

Little James Creek
The Little James Creek/ James Creek watershed drains numerous adits, shafts, and tailings piles within a part of the Jamestown Mining District, including the Burlington, Emmit, and Golden Age Mines. The area was primarily developed for its lead-silver, fluorspar, and uranium deposits. Aqueous samples collected 6/98 from Little James Creek show elevated concentrations of the following total and dissolved metals; beryllium, lead, manganese, sodium, thallium, and zinc.

1.4.1.2 Step 2: Identify the Decision

This step identifies the principal study question, defines alternative actions, and develops a decision statement. To accomplish the objective of the investigation (i.e., whether or not water quality meets established standards and to quantify the existing load), study questions must be developed. For this investigation, the study questions are as follows:

> What are the load contributions of the various sources in the watershed for the metals of concern? What reductions are needed to meet water quality standards?
>
> Are concentrations of metals of concern in waters of the Left Hand Watershed meeting established water quality standards?
>
> Are concentrations of site-related contaminants in sediments of the Left Hand Watershed acceptable for maintaining a healthy benthic macroinvertebrate community and cold water fishery?
>
> Are concentrations of site-related contaminants in aquatic prey species safe for predatory

species?

Are physical habitat alterations contributing to reduced aquatic life in the Left Hand Watershed?

Are the sediment loads from Off Road Vehicle affecting the biological community in the watershed?

Are nutrient concentrations in the watershed elevated indicating potential leakage of individual septic systems?

If the answer is yes, the following actions may be taken:

- Complete additional investigations to determine what areas within the watershed require and the feasibility of identified remedial actions.

1.4.1.3 Step 3: Identify the Inputs to the Decision

The purpose of this step is to identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statements discussed in Step 2. Since the objective of this investigation is to determine a the current water quality, quantify the load and assess the population of aquatic organisms both the species composition and tissue concentration, the following data are needed and will be collected through field study and sampling.:

- Current site-related chemical concentrations in surface water, groundwater, and sediment with paired flow measurements in the watershed.
- Current population demographics and tissue concentrations of representative aquatic organisms in the Left Hand Watershed.
- Current nutrient concentrations of surface water.
- Current riparian and in-stream habitat condition and physical sediment composition.

Historic data will drive decisions too – should add as applicable

- Historical surface water and sediment data in the watershed.
- Historical and new data for other parameters
- Cleanup levels or other benchmarks and standards used for comparison

The information collected during this investigation will enable the stakeholder group to make informed choices regarding additional study needs and remedial actions.

1.4.1.4 Step 4: Define the Study Boundaries

The spatial and temporal boundaries of the proposed investigation are described in Step 4 of the DQO process. Step 4 defines when and where data are to be collected. Section 4.0 of the project-specific Field Sampling Plan describes the proposed sampling design for this investigation. In general terms, the geographic limits of the study area include:

- The Little James Creek, James Creek and tributaries, and Left Hand Creek and tributaries

The temporal boundary for the water quality investigation is controlled by the most appropriate times of the year to collect surface water/sediment, macroinvertebrate, source/soil data. The schedule for the sampling events will be decided based on review of existing monitoring data collected by other stakeholders and from local observations regarding stream flow in the watershed.

1.4.1.5 Step 5: Develop a Decision Rule

The decision rule for this project depends on whether the water quality in the Left Hand Watershed has met identified water quality standards for what analytes at what standards. Could add a table to show the benchmarks/stds we're using. If those standards are not met, the decision will be either to determine what sources contribute the greatest load and prioritize those sites for clean up actions.

If water quality standards are met, then no further action will be needed. If not, then the frequency and duration of standards exceedence and the effects to aquatic life will be evaluated to determine what if any actions are needed. Additional investigations may be undertaken to determine the nature and practicality of possible source removal/remedial alternatives.

1.4.1.6 Step 6: Specify Tolerable Limits on Decision Errors

Decision maker's tolerable limits on decision errors, which are established performance goals for the data collection design, are specified in this step. Decision makers are interested in knowing the true value of the constituent concentrations. Since analytical data can only estimate these values, decisions that are based on measurement data could be in error. These errors are:

(1) Concentrations may vary over time and space. Limited sampling may miss some features of this natural variation because it is usually impossible or impractical to measure every point of a population. Sampling design errors occur when the sampling design is unable to capture the complete extent of natural variability that exists in the true state of the environment.
(2) Analytical methods and instruments are never absolutely perfect, hence a measurement

can only estimate the true value of an environmental sample. Measurement error refers to a combination of random and systematic errors that inevitably arise during the various steps to the measurement process.

The combination of sampling design and measurement error is the total study error. Since it is impossible to completely eliminate total study error, basing decisions on sample concentrations may lead to a decision error. The probability of decision error is controlled by adopting a scientific approach in which the data are used to select between one condition (the null hypothesis) and another (the alternative hypothesis). The null hypothesis is presumed to be true in the absence of evidence to the contrary. For this project the null hypothesis is that the true value of the constituents are above the water quality standards. The alternative hypothesis is that the true values of the constituents are below the water quality standards.

A false positive or "Type I" decision error refers to the type of error made when the null hypothesis is rejected when it is true and a false negative or "Type II" decision error refers to the type of error made when the null hypothesis is accepted when it is false. For this project, a Type I decision error would result in deciding that the inorganic constituent concentrations are below the action levels when they are not. A Type II decision error would result in deciding that the inorganic constituent concentrations are not below the standards action levels when they are.

For this project, a Type I error is less acceptable (worse case) than a Type II error because a Type I error could result in ecological and/or human harm whereas, a Type II error could result in remediation and further improvement in water quality.

Due to the complexity of the site and seasonal variations of contaminant levels in various sources throughout the site, several years of sampling effort, measured at critical time periods should decrease the amount of error involved in this project. By taking many measurements over a long period of time, overall improvements in water quality and trends aquatic life should be accurately measured and the impact of errors from a single sample or sampling event should be minimized. It is anticipated that the overall trend of water quality and biological life will be of critical importance in the final decision on water quality and the need for any further remedial action.

1.4.1.7 Step 7: Optimize the Design for Obtaining Data

EPA with the approval of CDPHE designed the surface water, sediment, and biological sampling program and habitat assessment. If additional sampling locations need to be dropped, added, changed or the schedule of sampling needs to be altered to improve sampling design, they will be. Evaluation of the effectiveness of the sampling program will be performed on a continuous basis.

1.4.2 Data Measurement Objectives

Every reasonable attempt will be made to obtain a quality and acceptable set of usable field measurements and analytical data. If a measurement cannot be obtained or is unusable for any reason, the effect of the missing or invalid data will be evaluated. In order to determine data usability, data quality indicators consisting of precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) will be evaluated, as described in Section 1.4.2.2

1.4.2.1 Quality Assurance Guidance

The field QA program has been designed in accordance with EPA's guidance for the Data Quality Objectives Process, EPA QA/G4 (August 2000), and EPA Requirements for Quality Assurance Project Plans, QA/R-5 (EPA 2001).

1.4.2.2 Precision, Accuracy, Representativeness, Completeness, Comparability and Sensitivity Parameters

PARCCS are indicators of data quality, PARCCS goals are established to aid in assessing data quality. The following paragraphs define PARCCS parameters associated with this project.

Precision. The precision of a measurement is an expression of mutual agreement among individual measurements of the same property taken under prescribed similar conditions. Precision is quantitative and most often expressed in terms of relative percent difference (RPD). Precision of the laboratory analysis will be assessed by comparing original and duplicate results. The RPD will be calculated for each pair of duplicate analyses using the following equation:

$$RPD= |S - D| \times 100/((S+D) /2)$$

Where:

S = First sample value (original Value)
D = Second sample value (duplicate value)

Precision of reported results is a function of inherent field-related variability plus laboratory analytical variability, depending on the type of QC sample. Various measures of precision exist depending upon "prescribed similar condition." Field duplicate samples will be collected to provide a measure of the contribution to overall variability of field-related sources. Acceptable RPD limits for field duplicate measurements will be less than or equal to $\leq$ 20% for aqueous matrices. Contribution of laboratory-related sources to overall variability is measured through various laboratory QC samples. Acceptable RPD limits for laboratory measurements are provided in Table 1-1.

Accuracy. Accuracy is the degree of agreement of a measurement with an accepted reference or true value and is a measure of the bias in a system. Accuracy is quantitative and usually expressed as the percent recovery (%R) of a sample result. The %R is calculated as follows:

$$\% \text{ Recovery} = (SSR - SR / DA) \times 100$$

Where:

SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

Ideally, it is desirable for the reported concentration to equal the actual concentration present in the sample. Analytical data will be evaluated for accuracy. Matrix spikes (MS) and / or laboratory control samples/laboratory control sample duplicates (LCS/LCSDs) will be used, whichever is applicable. Acceptable % R for analytical data associated with this investigation are provided in Table 1-1.

Representativeness. Representativeness expresses the degree to which sample data accurately and precisely represent the following:

- The characteristic being measured
- Parameter variations at a sampling point
- An environmental condition.

Representativeness is a qualitative and quantitative parameter that is most concerned with the proper design of the sample plan and the absence of cross-contamination of samples. Acceptable representativeness will be achieved through (1) careful, informed selection of sampling locations, (2) selection of testing parameters and methods that adequately define and characterize the extent of possible contamination and meeting the required parameter reporting limits, (3) proper gathering and handling of samples to avoid interferences and prevent contamination and loss, and (4) use of uncontaminated sample containers as the sample collection tool, eliminating

the need for decontamination of sampling equipment and possible cross contamination of samples.

Representativeness is a consideration that will be employed during all sample location and collection efforts. The representativeness will be assessed qualitatively by reviewing the procedures and design of the sampling event and quantitatively by reviewing the laboratory blank samples. If an analyte is detected in a laboratory blank, any associated positive result less than five times the detected concentration of the blank may be considered undetected. Field blanks will not be collected during this investigation.

Completeness. Completeness is a measure of the amount of usable data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Usability will be determined by evaluation of the PARCCs parameters excluding completeness. Those data that are reviewed and need no qualification or are qualified as estimate or undetected are considered usable. Rejected data are not considered usable. Completeness will be calculated following data evaluation. A completeness goal of 90% is projected for the data set collected for this investigation. If the completeness goal of 90% is not met, additional sampling may be necessary to adequately achieve project objectives.

Completeness is calculated using the following equation:

$$\% \text{ Completeness} = (DO/DP) \times 100$$

Where:
DO = Data Obtained and usable
DP = Data Planned to be obtained

Comparability. Comparability is a qualitative parameter. Consistency in the acquisition, handling, and analysis of samples is necessary for comparison of results. Data developed under this investigation will be collected and analyzed using standard EPA analytical methods and QC procedures to ensure comparability of results with other analyses performed in a similar manner. Data resulting from this field investigation may subsequently be compared to other data sets.

Sensitivity. Sensitivity is the achievement of method detection limits and depends on instrument sensitivity and sample matrix effects. Therefore, it is important to monitor the sensitivity of data-gathering instruments to ensure that data quality is met through constant instrument performance. Instrument sensitivity will be monitored through the analysis of blanks. Reporting limits are presented in Table1-1.

1.4.2.3. Field Measurements

Field data will be collected as outlined in the surface water, biological, sediment monitoring and habitat assessment sampling plan.

1.4.2.4 Laboratory Analysis

Guidelines for analytical methods, reporting limits, holding times, and QC analyses are discussed below. The sampling and analysis plan provides laboratory analytical methods and reporting limits applicable to that study.

Analytical Methods

Laboratory analysis will be conducted at the EPA Region VIII Laboratory by the Region Lab and ESAT contract and at CLP. Surface water, sediment and biological samples collected under this QAPP will be analyzed for the following parameters using analytical methods identified below:

EPA Region 8 Lab Analytical Methods:
Dissolved Organic Carbon (EPA Method 415.1)
Sulfate (EPA Method 375.1-4)
Total phophorus (I-4600-85)
Total suspended solids (EPA Method 160.2)
Turbidity (EPA Method 180.1)

ESAT Analytical Methods:
For metals 200.7 and 200.8.
Anions 300.0
TDS 160.1
TSS 160.2
Hardness 2340B
Alkalinity 310.1 or 310.2

ESAT are on the prep for total versus total recoverable metals. ESAT will follow SW846 method 3015 for total metals. The SOP is in progress now.

CLP Analytical Methods:
Soils/water ILM O 5.2 AEF
For dissolved/total metals ILM O 5.3 MS

ESAT Target Analyte List – ICP/MS

2004	MDL	CCV	ICV	ICSA	ICSAB	CRA	Spike	LCS	Units
Be 9	1	50	50	0.0	0.0	2	50	1000	ug/L
Al 27	10	50	50	10000	10000	20	2000	1000	ug/L
V 51	3	50	50	0	0	12	200	1000	ug/L
Cr 52	2	50	50	0.0	20.0	10	200	1000	ug/L
Mn 55	2	50	50	0.0	20.0	2	200	1000	ug/L
Co 59	0.2	50	50	0.0	20.0	1	200	1000	ug/L
Ni 60	0.4	50	50	0.0	20.0	1.5	200	1000	ug/L
Cu 65	5	50	50	0.0	20.0	10	200	1000	ug/L
Zn 66	3	50	50	0.0	20.0	10	500	1000	ug/L
As 75	1	50	50	0.0	20.0	5	100	2000	ug/L
Se 82	1	50	250	0.0	0.0	5	50	1000	ug/L
Mo 98	0.2	50	50	0.0	0.0	1	0	1000	ug/L
Ag 107	0.2	50	50	0.0	20.0	1	50	250	ug/L
Cd 114	0.2	50	50	0.0	20.0	1	50	1000	ug/L
Sb 121	0.5	50	50	0.0	0.0	10	200	2000	ug/L
Ba 135	0.3	50	50	0.0	0.0	2	500	1000	ug/L
Hg 202	0.5	2.5	0	0.0	0.0	2	0	0	ug/L
Tl 205	0.1	50	50	0.0	0.0	1	50	5000	ug/L
Pb 208	0.3	50	50	0.0	0.0	1	100	2000	ug/L
Th 232	0.1	50	50	0.0	0.0	0.5	0	0	ug/L
U 238	0.1	50	50	0.0	0.0	0.5	0	0	ug/L

MDL Determined: 1/13/2004

Reporting Limits

The reporting limits are presented in the sampling plan. If the result is between the instrument detection limit (IDL) and the reporting limit, the value will be reported as an estimated concentration and qualified by the laboratory. The achievement of the IDL depends on instrument sensitivity. It is therefore important for the laboratory to monitor the sensitivity of data-gathering instruments to ensure data quality through constant instrument performance checks.

Holding Times

Holding times are storage times allowed between sample collection and sample analysis when the designated preservation and storage techniques are employed. Required holding times must be considered when determining the method of shipment. Holding times and preservation for each analytical method used in specific investigations are provided in the surface water and sediment sampling plans.

Quality Control Analyses

To provide an external check of the quality of the field procedures and laboratory analytical data, field duplicate samples will be collected at a rate of 5% per media/event and submitted to the each laboratory, in accordance with standard QA protocol. Duplicate samples provide a check for sampling and analytical error. The frequency of duplicate sample collection that will be analyzed for the surface water investigation are discussed in Section 5.0 of the FSP of the surface water work plan. If disposable equipment is used to collect samples (eliminating the need for decontamination), equipment rinsate blanks may be omitted.

In addition to the external QA/QC controls, internal QA procedures are maintained by the laboratory. Internal QC samples may include laboratory blanks (i.e., method blanks, preparation blanks), laboratory duplications, matrix spikes, and laboratory control samples (known standards). Double volume samples will be collected for water samples at a rate of 5% and submitted for MS analysis. To ensure the laboratory analyzes MS's, designated samples will be labeled and noted on the chain-of-custody forms as extra volume sample for MS analyses.

1.5 Special Training Requirements

EPA and CDPHE, will ensure that qualified, experienced, and trained staff perform or oversee all data collection and sampling tasks. Each entity involved in this project is responsible for the safety of its employees.

1.6 Documentation and Records

Each laboratory will submit their standard analytical data reports to the either the EPA RPM or state project officer. Each data report will contain a case narrative that briefly describes the number of samples, the analyses, and any noteworthy analytical difficulties or QA/QC issues associated with the submitted samples. The data report will also include signed chain-of-custody forms, cooler receipt forms, analytical data, and a QC package. The CLP will provide both hard copy of the raw analytical data and a validated electronic spreadsheet of the final individual sample results. ESAT and the EPA laboratory will provide a paper hard copy and an electronic data deliverable with samples and quality assurance results. A PDF file of all data will be provided. The analytical data will be formatted to be compatible with CDPHE's EQUIS database and EPA's STORET database. The state project officer will be responsible for entering all data provided by the laboratories into their EQUIS database system, which will then be transferred into EPA STORET.

A record of samples, analyses, and field events will be kept in a field logbook.

Section 2
Measurement and Data Acquisition

This section covers sample process design and implementation, sampling methods requirements, handing and custody, analytical methods, QC, equipment maintenance, instrument calibration, supply acceptance, non-direct measurements, and data management. The field procedures are designed so that the following occurs:

- Sample collection is consistent with project objectives
- Samples are collected in a manner so that data represent actual Left Hand Watershed site conditions.

2.1 Sample Process Design

The general goal of the field investigation is to obtain surface water quality and sediment and biological data.. The number, types, and locations of samples are outlined in the surface water, sediment, biological and habitat sampling plan.

2.2 Sampling Methods Requirements

Sampling equipment, containers, and overall field management for the sampling and assessment is described below.

2.2.1 Sampling Equipment and Preparation

Equipment required for sampling, health and safety, documentation, and field parameter monitoring is presented in the sample plan.
Field preparatory activities include, procurement of field equipment, laboratory coordination, confirmation of site access (if necessary), as well as a field planning meeting that includes field personnel and QA staff.

2.2.2 Sample Containers

Clean polyethylene sample containers (or cubitainers) will be pre-rinsed with an aliquot of the water to be sampled, and then emptied before collecting and preserving (as required) samples in the field. The containers will be provided by the Region VIII Laboratory.

2.2.3 Sample Collection, Handling, and Shipment

Samples collected during this investigation consist of surface water, sediment, biological, and duplicate samples. Surface water sample collection procedures are outlined in the sampling and analysis plan and the *Compendium of Standard Operating Procedures* (EPA, 1996).

2.3 Sample Handling and Custody Requirements

Custody and documentation for field and laboratory work are described below, followed by a discussion of corrections to documentation.

2.3.1 Field Sample Custody and Documentation

The information contained on the sample label and the chain-of-custody record will match. The purpose and description of the sample label and the chain-of-custody record is discussed in the following sections.

2.3.1.1 Sample Labeling and Identification

An numeric coding system will identify each sample collected during sampling events. The coding system will provide a tracking record to allow retrieval of information about a particular sample and to ensure that each sample is uniquely identified. Sample numbers will correlate with locations to be sampled. The nomenclature that has been decided on was based on existing naming conventions established for this watershed in STORET.

Sample labels or tags will be completed and affixed to the appropriate sample containers. Preprinted labels may be used. These labels will be secured with waterproof tape and will include the sample identification number, the parameter (s) to be analyzed, the sampler's initials, and the preservative used. At the time of sample collection, a member of the field team will add the date and time of sample collection.

2.3.1.2 Chain-of-Custody Requirements

Chain-of-custody procedures and sample shipment will follow the requirements stated of the individual laboratories. CLP requires Forms II Lite. . The chain-of-custody record is employed as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through final data reporting. A complete chain-of-custody record is required to accompany each shipment of samples.

2.3.1.3 Sample Packaging and Shipping

Samples will be packaged and shipped in accordance with SOP No. 10 Sampling Handling, Documentation and Analysis. Samples will be placed in a cooler with ice. Custody seals will be placed over the cooler, then secured by tape. Samples collected by CDPHE, and ½ of the biological samples collected for species diversity will be shipped or delivered to:

John Gillis
EPA Region VIII laboratory
16194 W. 45^{th} Drive
Golden, CO 80403
(303) 312-7700 (main lab)
(303) 312-7824 John's Downtown Denver Office
(303) 312-7708 John's Lab Office

Sediment, surface water and biological samples collected for total and dissolved metals analysis and will be shipped or delivered to:

Contract Laboratory Services
Xxxx
Xxxx
Xxxx

Surface water samples collected for TSS, turbidity, total phosphorus and dissolved organic carbon; sediment samples for particle size analysis and the biological samples collected for species diversity analysis will be shipped or delivered to:

EPA Region VIII laboratory
16194 W. 45^{th} Drive
Golden, CO 80403
(303) 312-7700 (main lab)

2.3.1.4 Field Logbooks and Records

Field logbooks will be maintained by each field team. The log is an accounting of the accomplishment of scheduled activities, and will duly note problems or deviations from the governing plan and observations relating to the field program. The EPA RPM will be provided copies of the logbooks to include in the official project files.

2.3.2 Laboratory Custody Procedures and Documentation

EPA and ESAT Laboratory custody procedures are provided in the laboratory's QA management plan. Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipping cooler and the individual samples. This inspection will include measuring the temperature of the temperature blank within the cooler to document that the temperature of the samples is within the acceptable criteria (4 ± 2 degrees Celsius), if samples are cooled, and verifying sample integrity. The pH of the samples will also be measured, if preserved with an acid or base. The enclosed chain-of-custody records will be cross-referenced with all of the samples in the shipment. These records will then be signed by the laboratory sample custodian and copies provided to the EPA. The sample custodian will continue the chain-of-custody record process by assigning a unique laboratory number to each sample on receipt. This number will identify the sample through all further handling. It is the laboratory's responsibility to maintain internal logbooks and records throughout sample preparation, analysis, data reporting, and disposal. CLP uses its own SOPs.

2.3.3 Corrections to and Deviations from Documentation

For the logbooks, a single strikeout initialed and dated is required for documentation charges. The correct information should be entered in close proximity to the erroneous entry. All deviations from the guiding documents will be recorded in the field logbook (s). Any modifications to chain-of-custody forms will be made on all copies, The EPA RPM will be notified of any major changes or deviations.

2.4 Analytical Methods Requirements

The laboratory QA program and analytical methods are addressed below.

2.4.1 Laboratory Quality Assurance Program

EPA Region VIII laboratory, ESAT and CLP will be used as the laboratory for this investigation. Samples collected during this project for the EPA Lab and ESAT will be analyzed in accordance with methods determined by the EPA (see laboratory Quality Management Plan). CLP uses its own methods.

2.4.2 Methods

The methods to be used for chemical analysis will be determined by the EPA. The holding time requirements for each analytical method are determined by the analytical methods.

<u>Macroinvertebrate Sorting and Analysis and DOC</u>

In the laboratory, samples will be sorted and organisms will be identified to the lowest practical taxonomic level (genus or species for most taxa; subfamily for chironimids).

Bioavailibility of heavy metals in the field will be measured using the fiter-feeding caddisfly *Arctopsyche Grandis* (Trichoptera: Hydropsychidae). *Arctopsyche* is a relatively large, widely-distributed caddisfly found in many Rocky Mountain streams. Because *Arctopsyche* is highly tolerant of heavy metals, this species can be collected from both reference and metal-contaminated sites. Caddisflies will be collected from field sites, placed in 20 mL acid-rinced vials and immediately placed on ice. Where possible, replicate samples (n=3) will be collected from field sites. Where available, heptageniid mayflies, a grazer, will also be collected. Metal analysis will done using ICP-MS.

2.5 Quality Control Requirements

Field, laboratory, and internal office QC are discussed below.

2.5.1 Field Quality Control Samples

Each field duplicate will be collected at a single sampling location and collected identically and consecutively over a minimum period of time. This type of field duplicate measures the total system variability (field and laboratory variance), including the variability component resulting from the inherent heterogeneity of the medium. Field duplicates will be collected at a minimum frequency of one per 20 samples per media/event.

2.5.2 Laboratory Quality Control Samples

EPA Region VIII, ESAT and CLP laboratories will follow all laboratory QC checks, which may include matrix spikes, laboratory control samples, laboratory duplicates and laboratory blanks (i.e., method blanks, preparation blanks).

2.5.2.1 Internal Quality Control Samples

QC data are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of glassware and reagents. Each type of laboratory-based QC sample will be analyzed at a rate of 5% or one per batch (batch is a group of up to 20 samples analyzed together), whichever is more frequent. Results of the QC will be included in the data package and QC samples will consist of laboratory duplicates, laboratory blanks, MSs, and LCS/LCSDs, whichever is applicable, and any other method-required QC samples.

Laboratory blank samples will be analyzed to assess possible contamination so that corrective measures may be taken, if necessary. Laboratory duplicate samples are aliquots of a single sample that are split on arrival at the laboratory or upon analysis. Results obtained for two replicates that are split in a controlled laboratory environment will be used to assess laboratory precision of the analysis. MS and LCS analyses may be used to determine both precision and accuracy.

2.5.2.2 Laboratory Quality Control Checks

A calibration standard is prepared in the laboratory by dissolving a known amount of a standardized compound in an appropriate matrix or dilution. The final concentration calculated from the known quantities is the true value of the standard. Where applicable, reference standard solutions will be traceable to the National Institute of Standards and Technology or other nationally recognized source. The analysis results obtained from these standards are used to prepare a standard curve and, thereby, quantify the compounds found in the environment samples.

The number of calibration standards is prescribed by each individual analytical method procedure.

2.5.3 Internal Quality Control Checks

Internal QC checks will be conducted throughout the project to evaluate the performance of the project team during data generation. All internal QC will be conducted in accordance with the applicable procedures listed below:

- All project deliverables will receive technical and QA reviews prior to being issued. Completed review forms will be maintained in the project files
- Corrective action of any deficiencies is the responsibility of the ESAT/EPA/CLP manager.

2.6 Equipment Maintenance Procedures

All laboratory equipment will be maintained in accordance with the laboratory's SOPs.

2.7 Instrument Calibration Procedures and Frequency

Calibration of field and laboratory instruments is addressed in the following subsections.

2.7.1 Field Instruments

Field instruments used to measure data will be used during this investigation. Field measurements will include flow measurements and surface water pH, temperature, and specific conductance. Portable meters will be used to obtain field measurements. The instrument will be calibrated prior to use each day and as often as needed to maintain calibration in accordance with the manufacturer's instruction.

2.7.2 Laboratory Equipment

Calibration of laboratory equipment will be based on written procedures approved by laboratory management. Instruments and equipment will be initially calibrated and continuously calibrated at required intervals as specified by either the manufacturer or more updated requirements (e.g., methodology requirements).

Records of initial calibration, continuing calibration and verification, repair and replacement will be filed and maintained by the laboratory. Calibration records will be filed and maintained at the laboratory location where the work is performed and may be required to be included in evaluation data reporting packages.

2.8 Acceptance Requirements for Supplies

Prior to acceptance, all supplies and consumables will be inspected by the EPA, CDPHE contractor or University of Colorado student field sampling team or other contractors to ensure that they are in satisfactory condition and free of defects.

2.9 Non-direct Measurement Data Acquisition Requirements

Sampling locations within the site have been established prior to this investigation. No non-direct measurement data acquisition requirements exist at this time.

2.10 Data Management

Each laboratory will submit their standard analytical data reports to the either the EPA RPM or state project officer. Each data report will contain a case narrative that briefly describes the number of samples, the analyses, and any noteworthy analytical difficulties or QA/QC issues associated with the submitted samples. The data report will also include signed chain-of-custody forms, cooler receipt forms, analytical data, and a QC package. The CLP will provide both hard copy of the raw analytical data and a validated electronic spreadsheet of the final individual sample results. ESAT and the EPA laboratory will provide a paper hard copy and an electronic data deliverable with samples and quality assurance results. A PDF file of all data will be provided. The analytical data will be formatted to be compatible with CDPHE's EQUIS database and EPA's STORET database. The state project officer will be responsible for entering all data provided by the laboratories into their EQUIS database system, which will then be transferred into EPA STORET.

After validation by CDPHE, data will be made available to EPA, University of Colorado on CD's updated quarterly and other parties through the STORET website. .

Section 3
Assessment and Oversight

Assessments and oversight reports are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also address activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities and serve to keep management current on field activities.

3.1 Assessments and Response Actions

3.1.1 Assessments

Performance assessments are quantitative checks on the quality of measurement systems. Performance assessments for the laboratory can include "blind" reference samples, samples of known concentration. The samples may be included in the sampling stream to evaluation laboratory performance.

System assessments are qualitative reviews of different aspects of project work to check on the use of appropriate QC measures and the functioning of the QA system. System assessments include field and office audits. EPA and CDPHE will each be responsible for overseeing the quality control aspects of each of their contractors. EPA is responsible for the overall Quality Control assessment of the project and may perform system audits at any time.

3.1.2 Response Actions

Response Actions will be implemented on a case-by-case basis to correct quality problems. Minor response actions taken in the field to immediately correct a quality problem will be documented in the applicable field logbook and verbally reported to the EPA RPM. Major response actions taken in the field will be approved by the EPA RPM prior to implementation of the change. Such actions may include revising field procedures, re-sampling and/or retesting, changing sampling frequency, etc. Quality control problems that cannot be corrected quickly through routine procedures require implementation of a corrective action request (see figure 3-1). This action can be initiated by the RPM or field personnel if the need arises.

3.2 Reports to Management

QA reports to the RPM will be provided whenever quality problems are encountered. Field teams will note any quality problems in the applicable logbook or other form of documentation.

Section 4 Data Validation and Usability

Laboratory results will be reviewed for compliance with project objectives. The EPA Laboratory and ESAT contractors will be responsible for validation of their surface water laboratory data

4.1 Validation and Verification Methods

Data validation consists of examining the data packages against pre-determined standardized requirements set forth in this QAPP and referenced methods. The validator examines the reported results, QC summaries, case narrative, instrument calibration runs, chain-of-custody information, raw data, QC samples, calibration, blank results, and other information as appropriate to the data package. The validator checks to determine if project quality objectives were met in the analysis of the data and qualifies data according the National Functional Guidelines for data review.

4.2 Reconciliation with Data Quality Objectives

The analytical data will be provided to all interested parties and decision makers. The data will be examined to determine compliance with water quality standards and quantification of potential sources. In addition, the data collected for this project will be used to help proritize cleanup sites.

Left Hand Watershed QA Corrective Action Request

Project:

Requested by:________________________________ Date:
Condition noted:

Is condition adverse to Quality of project? Yes ____ No_____
Person/organization responsible____

Requested Change:

Corrective Action(s) taken to correct problem (to be filled out by person responsible, use additional pages if needed).

Corrective Action Plan Accepted______________________ Date:_______________________

Verified by:____Date:_______________________

Corrective Action Accepted_______________________ Date:_______________________

APPENDIX A3

Agency Sampling Worksheet

LEFTHAND WATERSHED
Agency Sampling Worksheet

	Program/Stakeholder						
	LWOG/CU	**CDPHE**	**EPA**	**USFWS**	**USGS**	**USFS**	**JCWI**
Area/Segment	Little James (above Argo to James Cr)	Brownfields: Argo only Superfund: Captain Jack	Watershed		Whole watershed	Loder Smelter Wano tailings – Jamestown Golden Age/ Castle Gulch Castle Gulch down to Lefthand water intake	James Creek -Peak to Peak to Jamestown Little James Creek at mouth
Media Sample#/ Locations	Water Tracer dilution/ metal loading test ~ 30 sample locations	Brownfields: SW = 2-3 locations Soils = 5-15 SF: Soils, sedm, water-sw/gw, biota	As needed	Invertebrate Field sampling -possibly fish (will coordinate with USGS, USFS, EPA & CDOW for fish tissues	Streambed sediment, surface water – total/dissolved Up to 30 sites	Water – 3 locations Soil – 3 locations Invertebrates	Water quality, some turbidity Basic chemistry and metals (total and dissolved) 6 sites –capture impacts from John Jay Mine, Fairday Mine and Little James cumulative
Timing / Freq. Needed eg 1 yr, 2yr, 12yr	~end of "local" snowmelt ~Late March, April?	High / low flows High/low Seasonal, two years	High/ low flows		One time	High/low flow 2 times/year	Monthly (currently)
When Sampling Planned/ Wanted	Late March, April	High – March Low – Aug/ September 2004	The sooner the better for the EPA lab.		Low flow	Spring Fall	Currently continuous -wish to expand area/ extent downstream
Analyses Needed	Metals, Cu, Zn, Pb, Fe, Mn, Al, Ca, Mg at a min.	Total/dissolved metals WQ for piper stifts diagrams Total/dissolved metals, alkalinity, hardness	Total/ dissolved metals, hardness, macroinvertebrate	Community (ID species) Tissue concentrations (fish & invert)	Metals	Total/dissolved metals Inverts – community ID Tissue Analysis TDS/ turbidity/ TSS	TSS/ Macroinvertebrates,/pebble count – imbeddedness
Analyzed by Who	Need help ($ running out)	Analytica EPA	EPA Lab ESAT (Lab)	EPA, CSU (CDPHE)?	USGS - internal	Water samples to contract lab. Inverts?	Division of Wildlife (Riverwatch)
EPA Capacity Lead Time needed	Help with analysis						EPA QAPP